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AN ANALYSIS OF THE BENEFITS AND APPLICATION OF EARNED VALUE MANAGEMENT (EVM) PROJECT MANAGEMENT TECHNIQUES FOR DOD PROGRAMS THAT DO NOT MEET DOD POLICY THRESHOLDS

December 2017

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The primary objective of this research was to demonstrate how Earned Value Management (EVM) principles can be applicable for non-major programs that spend money within the Department of Defense. This Joint Applied Project provided a tailorable EVM approach, both for contracts that do not meet the threshold, and contracts that have a waiver and need modified levels of cost, schedule and performance reporting. The immediate objective of this research project was to examine the question: Can the application of EVM-Lite project management techniques improve the reporting metrics to assess acquisition category (ACAT) II and III cost and schedule performance trends across programs? The JAP examined the background of present cost and schedule reporting currently being used for non-major DOD programs. A comparative analysis was conducted on ACAT II and III programs to define the key issues related to accuracy, completeness, and consistency with data received by the contractor to measure performance. The results indicated that by the use of EVM techniques, ACAT II and III programs can improve data reliability and effectively measure cost and schedule performance. An example of the EVM concepts was demonstrated as a starting point and where tailoring is appropriate.

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ABSTRACT

The primary objective of this research was to demonstrate how Earned Value Management (EVM) principles can be applicable for non-major programs that spend money within the Department of Defense. This joint applied project, or JAP, provided a tailorable EVM approach, both for contracts that do not meet the threshold, and contracts that have a waiver and need modified levels of cost, schedule, and performance reporting. The immediate objective of this research project was to examine the question: Can the application of EVM-Lite project management techniques improve the reporting metrics to assess acquisition category (ACAT) II and III cost and schedule performance trends across programs? The JAP examined the background of present cost and schedule reporting currently being used for non-major DOD programs. A comparative analysis was conducted on ACAT II and III programs to define the key issues related to accuracy, completeness, and consistency with data received by the contractor to measure performance. The results indicated that by the use of EVM techniques, ACAT II and III programs can improve data reliability and effectively measure cost and schedule performance. An example of the EVM concepts was demonstrated as a starting point and where tailoring is appropriate.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACAT: Acquisition Category

ANSI/EIA: American National Standards Institute/Electronic Industries Alliance

BAC: Budget at Completion

BCWP: Budget Cost for Work Performed

BCWS: Budgeted Cost for Work Scheduled

CA: Control Account

CAM: Control Account Manager

CAP: Control Account Plan

CBB: Contract Budget Baseline

CES: Cost Element Structure

COTS: Commercial off-the-Shelf

CPI: Cost Performance Index

CV: Cost Variance

DAU: Defense Acquisition University

DCMA: Defense Contract Management Agency

DID: Date Item Description

DOD: Department of Defense

EAC: Estimate at Completion

ETC: Estimate to Complete

EVM: Earned Value Management

EVMS: Earned Value Management System

IBR: Integrated Baseline Review

IMP: Integrated Master Plan

IMS: Integrated Master Schedule

IPMR: Integrated Program Management Report

LOE: Level of Effort

MDAP: Major Defense Acquisition Program

MR: Management Reserve

OBS: Organization Breakdown Structure

PARCA: Performance Assessments and Root Cause Analyses

PB: President Budget

PEO: Program Executive Office

PM: Program Manager

PMB: Performance Measurement Baseline

QRA: Quantitative Risk Assessment

SPI: Schedule Performance Index

SV: Schedule Variance

TCPI: To Complete Program Index

VAR: Variance Analysis Review

WBS: Work Breakdown Structure

WP: Work Package

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I. INTRODUCTION

A. BACKGROUND

1. What Is EVM?

Earned Value Management (EVM) is a program management tool that integrates cost, schedule, and technical performance of a contract. It is considered by the Department of Defense (DOD) to be the best available tool for effectively managing large and complex acquisition programs. Nonetheless, the ability to utilize this tool to perform successful program management is highly dependent on the implementation approach of EVM. EVM is mandated by law for cost/incentive government contracts greater than $20 million based on DODI 5000.02. Currently, the DOD provides no official policy or guidelines for using Earned Value Management (EVM) methods for programs that do not meet thresholds, resulting in a potential lack of measuring cost, schedule, and technical performance. As a direct impact, Project Managers (PMs) may not understand how to sufficiently use industry standard program management tools or metrics to monitor contractor performance on non-major defense programs. As revealed in the 2015 publication *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* by the Government Accountability Office (GAO), non-major programs "include everything from a multibillion dollar aircraft radar modernization program to soldier clothing and protective equipment programs in the tens of millions of dollars" (sec. 1). The GAO report further noted that the DOD must "take steps to improve data reliability, and determine how to measure cost and schedule performance" (sec. 1) on non-major programs. The report identified the need for improved management as a result of "widespread data entry issues, missing data, and inconsistent identification of current ACAT II and III programs" (sec. 1). The GAO points out that DOD components' current efforts to improve ACAT II and III data are not addressing the problems holistically. Program Offices who are ultimately responsible for managing acquisition programs may not be able to make the best decisions possible. As a result, programs could be at greater risk of cost and schedule overruns that negatively affects every stakeholder. The GAO (2015) further noted, in

order for the government to accurately account for how they are spending money and to track whether they are meeting cost and schedule objectives on smaller acquisition programs, it is important they have timely and reliable cost schedule and performance data.

The Office of Performance Assessment and Root Cause Analyses (PARCA) is the only office that is responsible and accountable for EVM policy across DOD ("Earned Value Management," n.d.). EVM is an industry best practice for program management in the commercial sector as well as the government. EVM is a systematic process that finds variances in projects by providing quantitative contract performance data. It compares actual work performed against work planned. In traditional management the structure only compares the budget to the actual expenditures completed on a project. Unlike EVM, traditional management does not provide the Earned Value of the physical work completed. Figure 1 portrays the traditional project management measurement techniques to EVM. The application of EVM uses primary data points, derived data points, variances, and performance indices to track a project; all the formulas can be found in the Figure 2 on the EVM 'Gold Card' ("Earned Value Management General Reference," n.d.). On the Department of Energy (DOE) Earned Value Management website (n.d.), the organization noted that "EVM is a systematic approach to the integration and measurement of performance of scope, schedule, and budget accomplishments on a project or task" (para. 1). The DOE illustrates the tool provides "both the government and contractors the ability to examine detailed schedule information, critical program and technical milestones" (para. 1) integrated with the associated budget and cost data. EVM is considered by the Department of Defense (DOD) to be the best available tool for effectively managing large and complex acquisition programs.

Program Managers (PM) use EVM to assess cost, schedule and technical performance to "support proactive decision-making as they navigate the constraints and risks that programs face on a daily basis" ("DOD EVMS Interpretation Guide [EVMSIG]," 2015, p. 2). EVM is an effective process that will help balance programmatic and operational requirements while executing and delivering prime mission products to the warfighters.

Figure 1.   Traditional Measurement vs. Earned Value Measurement. Source:
Evolutionary Acquisition – Complex Systems (2017).

Earned Value Management 'Gold Card'
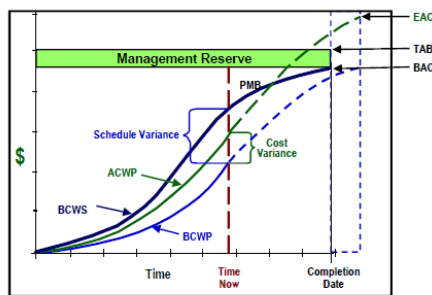
VARIANCES — Favorable is Positive, Unfavorable is Negative

Cost Variance	$CV = BCWP - ACWP$	$CV\% = (CV / BCWP) * 100$
Schedule Variance	$SV = BCWP - BCWS$	$SV\% = (SV / BCWS) * 100$
Variance at Completion	$VAC = BAC - EAC$	

OVERALL STATUS

% Schedule $= (BCWS_{CUM} / BAC) * 100$
% Complete $= (BCWP_{CUM} / BAC) * 100$
% Spent $= (ACWP_{CUM} / BAC) * 100$

DoD TRIPWIRE METRICS — Favorable is > 1.0, Unfavorable is < 1.0

Cost Efficiency $CPI = BCWP / ACWP$
Schedule Efficiency $SPI = BCWP / BCWS$

BASELINE EXECUTION INDEX (BEI) (Schedule Metric)
$BEI = $ # of Baseline Tasks Actually Completed / # of Baseline Tasks Scheduled for Completion

CRITICAL PATH LENGTH INDEX (CPLI) (Schedule Metric)
$CPLI = ($Critical Path Duration + Float Duration$_{(to\ baseline\ finish)}) / $ Critical Path Duration

TO COMPLETE PERFORMANCE INDEX (TCPI) # §
$TCPI_{EAC} = $ Work Remaining / Cost Remaining $= (BAC - BCWP_{CUM}) / (EAC - ACWP_{CUM})$

ESTIMATE AT COMPLETION #
$EAC = $ Actuals to Date $+ [($Remaining Work$) / ($Efficiency Factor$)]$
$EAC_{CPI} = ACWP_{CUM} + [(BAC - BCWP_{CUM}) / CPI_{CUM}] = BAC / CPI_{CUM}$
$EAC_{Composite} = ACWP_{CUM} + [(BAC - BCWP_{CUM}) / (CPI_{CUM} * SPI_{CUM})]$

To Determine a Contract Level TCPI or EAC; You May Replace BAC with TAB
§ To Determine the $TCPI_{BAC\ or\ LRE}$ Replace EAC with BAC or LRE
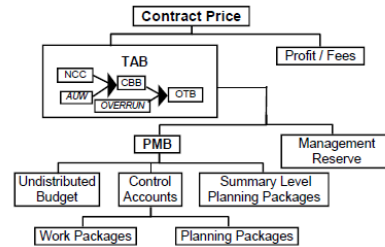
TERMINOLOGY

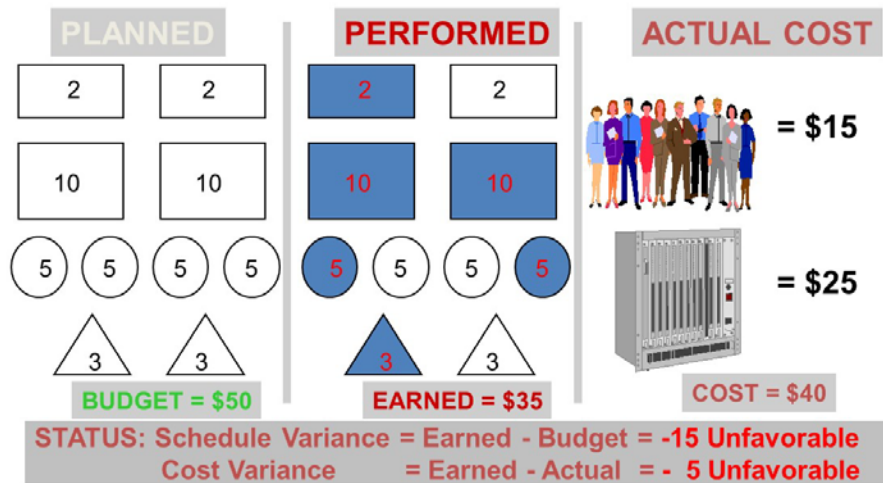|		
NCC	Negotiated Contract Cost	Contract price less profit / fee(s)
AUW	Authorized Unpriced Work	Work contractually approved, but not yet negotiated / definitized
CBB	Contract Budget Base	Sum of NCC and AUW
OTB	Over Target Baseline	Sum of CBB and recognized overrun
TAB	Total Allocated Budget	Sum of all budgets for work on contract = NCC, CBB, or OTB
BAC	Budget At Completion	Total budget for total contract thru any given level
PMB	Performance Measurement Baseline	Contract time-phased budget plan
MR	Management Reserve	Budget withheld by Ktr PM for unknowns / risk management
UB	Undistributed Budget	Broadly defined activities not yet distributed to CAs
CA	Control Account	Lowest CWBS element assigned to a single focal point to plan & control scope / schedule / budget
WP	Work Package	Near-term, detail-planned activities within a CA
PP	Planning Package	Far-term CA activities not yet defined into WPs
BCWS	Budgeted Cost for Work Scheduled	Value of work planned to be accomplished = PLANNED VALUE
BCWP	Budgeted Cost for Work Performed	Value of work accomplished = EARNED VALUE
ACWP	Actual Cost of Work Performed	Cost of work accomplished = ACTUAL COST
EAC	Estimate At Completion	Estimate of total cost for total contract thru any given level; may be generated by Ktr, PMO, DCMA, etc. = $EAC_{Ktr / PMO / DCMA}$
LRE	Latest Revised Estimate	Ktr's EAC or EAC_{Ktr}
SLPP	Summary Level Planning Package	Far-term activities not yet defined into CAs
TCPI	To Complete Performance Index	Efficiency needed from 'time now' to achieve an EAC

EVM POLICY: DoDI 5000.02, Encl 4, Table 5. EVMS in accordance with ANSI/EIA-748 is required for cost or incentive contracts, subcontracts, intra-government work agreements, & other agreements valued ≥ $20M (Then-Year $). EVMS contracts ≥ $50M (TY $) require that the EVM system be formally validated by the cognizant contracting officer. Additional Guidance in Defense Acquisition Guidebook and the Earned Value Management Implementation Guide (EVMIG). EVMS is discouraged on Firm-Fixed Price, Level of Effort, & Time & Material efforts regardless of cost.

EVM CONTRACTING REQUIREMENTS:
Non-DoD FAR Clauses – Solicitation – 52.234-2 (Pre-Award IBR) or 52.234-3 (Post Award IBR)
– Solicitation & Contract – 52.234-4
DoD(≥ $20M) DFAR Clauses - 252.234-7001 for solicitations and 252.234-7002 for solicitations & contracts
Contract Performance Report – DI-MGMT-81466A * 5 Formats (WBS, Organization, Baseline, Staffing & Explanation)
Integrated Master Schedule – DI-MGMT-81650 * (Mandatory for DoD EVMS contracts)
Integrated Baseline Review (IBR) – Mandatory for all EVMS contracts
* See the EVMIG for CPR & IMS tailoring guidance.

EVM Home Page = https://acc.dau.mil/evm eMail Address: EVM.dau@dau.mil
DAU POC: (703) 805-5259 (DSN 655)
Revised January 2009

Figure 2.   DAU Gold Card. Source: Earned Value Management General Reference DAU Tool Kit (n.d.).

2.   History of EVM

The Department of Defense (DOD) has been using a form of EVM since 1967, as part of Cost/Schedule Control Systems Criteria. It arose as a new field of financial analysis that concentrated on planning and control that could measure performance. By 1996 the federal government formally went to EVM and by 1998 the American National Standards Institute (ANSI)/Electronic Industries Alliance (EIA) published guidelines for EVMS. By 2000 the *Guide to Project Management Body of Knowledge* (PMBOK Guide) provided the basic EVM terminology and details. The PMBOK defines EVM as "a management methodology for integrating scope, schedule, and resources, and for objectively measuring project performance and progress" ("PMBOK," 2013). ANSI/EIA-748 guidance for EVMS has five categories in that the 32 criteria of EVM are organized,

they are: Organization, Planning and Budgeting, Accounting, Analysis, and Revisions and Data Maintenance). The 32 criteria and categories have been streamlined and simplified over the years. ("Basic Concepts of Earned Value Management," n.d.).

3. EVM Applicability

Table 1 provides the requirement for EVM and "applies to cost or incentive contracts, subcontracts, intra-government work agreements, and other agreements that meet the dollar thresholds prescribed in the DOD Instruction 5000.02" (Department of Defense [DOD], 2017, p. 74). According to the DOD Instruction 5000.02, "EVM is required on cost or fixed price incentive contracts valued at or greater than $20 million" (DOD, 2017, p. 74). PMs must consider the scope of work and duration when determining the applicability of EVM. Requiring EVM for cost or fixed-price incentive contracts are typically used for large, complex contracts that may include research and development, prototypes, ground support systems and integration efforts.

Regardless of the dollar value, the use of EVM on Firm-Fixed Price (FFP) efforts is discouraged when the scope of the effort is based on non-developmental contracts, such as steady state operations and routine maintenance services (DOD, 2017). While EVM is not required on FFP contracts a PM may determine the need where cost and schedule visibility is necessary to plan and track project performance. PMs must request a waiver from the Milestone Decision Authority (MDA) in order to apply EVM on FFP contracts. The request must include a business case analysis that includes a rationale on why EVM is appropriate for this contract type (DOD, 2017).

OSD PARCA states that "the contractor should not be prohibited from employing its EVMS if the use of EVM is an ingrained corporate process. DOD, however, would not typically require formal EVM requirements on contracts to that EVM is not being applied, such as FFP contracts" ("EVM Frequently Asked Questions," n.d.).

Table 1.   EVM. Source: DOD (2017).

EVM Thresholds	
≥ $50 MILLION	**REQUIRED**
• Contracts for highly classified, foreign, and in-house programs. • Not required for: Firm-fixed price contracts. (Business case analysis and MDA approval required.) • Not recommended for: Contracts less than 12 months in duration. • May not be appropriate for: Non-schedule based contract efforts, e.g., level of effort.	• Must use ANSI/EIA-748 compliant and validated management system. • IPMR (all formats) is required. • Schedule Risk Assessment (SRA) is required
≥ $20 MILLION but < $50 MILLION	**REQUIRED**
• Includes: Contracts for highly classified, foreign, and in-house programs. • Not required for: Firm-fixed price contracts. (Requires business case analysis and MDA approval.) • Not recommended for: Contracts less than 12 months in duration. • May not be appropriate for: Non-schedule based contract efforts, e.g., level of effort.	• Must use ANSI/EIA-748 compliant management system. No validation. • IPMR Formats 1, 5, 6 &7 are required. OPTIONAL • IPMR Formats 2, 3, and 4 are optional. • Schedule Risk Assessment is optional.
< $20 MILLION	**REQUIRED**
• Evaluate management needs carefully to ensure only minimum information needed for effective management control is requested. • Requires cost-benefit analysis and PM approval. • Not recommended for: Contracts less than 12 months in duration. • May not be appropriate for: Non-schedule based contract efforts, e.g., level of effort.	• ANSI/EIA-748 compliance is discretionary and should be based on risk. • IPMR Formats 1, 5, 6 and 7 are recommended.

4.   EVM Principles

Earned Value Management is a program management tool that measures the amount of work completed on a project. EVM is considered by the Department of

Defense as the best available tool to effectively manage large and complex acquisitions programs. In simple terms, Earned Value or EV is a value added metric that is based on the planned budget to be completed as work scope. EVM is based on sound management principles that integrates scope, schedule and budget with technical risk into a baseline in that projects can be measured (Humphrys & Associates, 2012). The completed work scope is measured against the planned budget to determine the value of work completed or Budgeted Cost for Work Performed (BCWP). The integrated baseline offers metrics that highlights performance treads and program variances. This information provides Program Managers and higher levels of management within the DOD with quantitative metrics that enables more effective project management decisions.

The basis of an Earned Value Management System (EVMS) is defined by organization's set of integrated procedures, systems and practices that are defined within the ANSI/EIA-748. The key consideration in defining an EVMS is based on the nature of work. The performance management approach is based on the complexity, cost and schedule risks, as well as the external dependencies of the project. The approach used to define an EVM methodology will be based on the type of effort and whether or not the work scope is discrete, level of effort, agile, or apportioned (Humphrys & Associates, 2012). The Performance Measurement Technique (PMT) selected for a measuring work performance determines how earned value is calculated. Discrete work can be effectively measured using EVM concepts and tools. However, if the work is level of effort EVM becomes less effective for measuring progress. Deltek Cobra offers a number of PMT options for measuring the performance of a work package, including Percent Complete, 50–50, and 0–100 ("Cobra: Cost and Earned Value Management Made Easy," n.d.). EVMS with appropriate PMTs will help to identify problem areas that need immediate attention by providing early warnings and analysis to PMs. An EVMS system will aid both defense contractors and Program Managers with a robust tool for planning and measuring cost and schedule performance.

5.   EVM Framework

An Earned Value Management System (EVMS) consists of many parts. In its basic form, Earned Value Management (EVM) consists of 32 criteria that are identified in American National Standards Institute/Electronic Industries Alliance (ANSI/EIA) Standard-748, Earned Value Management Systems. The ANSI/EIA Standard identifies the 32 criteria that you must implement for a validated EVM system. The complete system includes the software (EV, Scheduling, and Accounting as a minimum), implementation, training, personnel, and procedures necessary to successfully operate a validated EVM System. The framework provides guidance on how design, implement, and operate an EVM system that will effectively achieve the criteria and subsequent system validation. Each criterion in the ASNI framework can be achieved in different ways. The criterion identify what must be achieved, not how to do it. The intent of ANSI/ EIA-748 is to provide management with a robust tool using existing company resources that are scaled to an EVMS application that successfully achieves program requirements, while meeting EVMS principles. ANSI/EIA-748 provides flexibility to defense contractors with the ability to best utilize existing systems and have the least change and expense in implementing EVM, but still achieve a system that helps to effectively manage a project.

The ANSI/EIA-748 Forward (1998) provides a good summary of what EVM and the criteria encompass:

> The earned value management system guidelines incorporate best business practices to provide strong benefits for program or enterprise planning and control. The processes include integration of program scope, schedule, and cost objectives, establishment of a baseline plan for accomplishment of program objectives, and use of earned value techniques for performance measurement during the execution of a program. The system provides a sound basis for problem identification, corrective actions, and management of replanning as may be required. The guidelines are purposely high level and goal oriented as they are intended to state the qualities and operational considerations of an integrated management system using earned value analysis methods without mandating detailed system characteristics. Different companies must have the flexibility to establish and apply a management system that best suits their management style and business environment. The system must, first and foremost, meet

8

the company needs and good business practices. (Electronic Industries Alliance, 1998)

Table 2 provides a detailed list of the 32 ANSI/EIA-748 criteria within the EVMS framework ("Earned Value Management Overview," n.d.).

Table 2.   EVM Guidelines. Source: AcqNotes – Earned Value Management (n.d.).

ANSI/EIA-748 EVMS Guidelines
Group 1 Organization
1 Define authorized work (WBS elements)
2 Identify organizational responsibilities
3 Integrate the system
4 Identify overhead management
5 Provide for performance measurement
Group 2: Planning, Scheduling and Budgeting
6 Schedule the work
7 Identify products, milestones and indicators
8 Plan the Performance Measurement Baseline (PMB)
9 Establish budgets for work
10 Identify work packages
11 Summarize work package budgets to control accounts
12 Identify and control level of effort
13 Establish overhead budgets
14 Identify management reserves and undistributed budget.
15 Summarize budgets to target cost
Group 3: Accounting
16 Record direct costs

ANSI/EIA-748 EVMS Guidelines
17 Summarize direct cost to the WBS
18 Summarize direct cost to the organization
19 Record indirect costs
20 Identify unit/lot costs
21 Record material costs
Group 4: Analysis
22 Identify schedule and cost variances
23 Analyze schedule and cost variances
24 Analyze indirect costs
25 Summarize data elements and variances for reporting
26 Implement managerial actions
27 Develop revised estimates of cost at completion
Group 5: Revisions
28 Incorporate changes into plans, budgets and schedules
29 Reconcile budgets changes
30 Control retroactive changes
31 Control revisions to the program budget
32 Document changes to the PMB

6.   **EVM Benefits**

EVM is based on good business practices that does not change based on a programs ACAT level. EVM measures defined tasks that meet the "SMART" test—they are Specific, Measurable, Actionable, Results-oriented, and Timely. There are many benefits to EVM, including:

- Integrated work, schedule, and cost using a Work Breakdown Structure (WBS). The WBS breaks down the resources used in each area.

- Centralized management control system; that focuses on managing data from one area of a system instead of multiple systems.

- Management by exception principle. This focuses on the most critical issues.

- Historical data from completed projects that can be used for comparative analysis. When information is collected over many years than it is possible to analyze success and failures for projects and use that data for future projects.

- Early Warning Indicator. Variances in cost and schedule can be detected early on. At 10 percent of completion variances will be visible.

- Cost Performance Index (CPI). CPI is calculated by dividing earned value by actual costs. CPI is also used in the Estimate at Completion (EAC) formula. When CPI is above 1 indicates a positive, project is progressing within budget.

- Schedule Performance Index (SPI). SPI is calculated by dividing earned value by planned value. A negative SPI indicates additional spending will be required. SPI identifies schedules spillages especially when integrated with critical path information.

- Index-Based Forecasting. This uses the SPI and CPI calculation to determine a range of EAC. When the value is outside the range it indicates an estimation system problem.

- Periodic Cost Performance Index as a benchmark. This uses CPI trend data at the WBS levels.

- To-Complete Performance Index (TPCI). TPCI is calculated by the work remaining divided by the money left. Also, shows the level of performance needed to meet budget. (Van Wyk, 2015)

7. EVM Limitations

EVM is a project management practice that offers PMs with many advantages, when properly applied. However, the practice also has its share of limitations. While EVM provides an integrated solution for oversight, it does not necessarily tell the whole story.

Some limitations of EVM include if the planned baseline is not correct and does not feed into the schedules than data will become garbage in, garbage out. Most stakeholders may not understand the terminology or the advance formulas associated with the actual data points and outputs therefore it is important to focus on the bottom line up front performance metrics. EVM concentrates on cost and schedule, but doesn't include quality measurements. Hence you can be within cost and on schedule, but you don't have a useable product at the end. Different methods of EVM data can be applied in different ways. For instance, you can use budget at completion or cost variances that could depict different favoring outcomes. In most cases there is no tracking of risk management within EVM. Therefore, the actual work completed may not be accurate. Finally, as the data is collected, the actual work completed may have changed drastically (Schulze, 2013).

B.   PURPOSE AND SIGNIFICANCE OF STUDY

In the Army today, non-Special Interest ACAT II and III programs account for ~80 percent of programs managed by PEOs and 45 percent of the $17.5 billion PB17 Procurement Budget (Barth, 2017; "Department of Defense Procurement Budget Fiscal Year 2017," 2016). As noted on the Army's Program Executive Office, Combat Support & Combat Service Support (PEO CS&CSS) website (n.d.), the organization "is specifically responsible for hundreds of diverse systems primarily related to sustainment, spanning the range of transportation, engineering, ordnance, quartermaster, and some maneuver portfolio platforms" (par 2). The PEO CS&CSS has the greatest portion of ACAT II and III programs in Army active management. Of the 148 active ACAT II and III programs, 55 percent of these programs have investment costs greater than $100 million and require a complexity of reporting requirements and system processes (Davis, 2017). The PEO continues to stress the importance of data quality to help manage real priorities between project portfolios.

Smaller defense programs need to make improvements that will enable a standardized government data collection methods across all weapon systems. ACAT II and III individual weapon systems typically result in less attention and oversight because

fewer dollars are spent by smaller programs. However, ACAT II and III programs represent a large percentage of the defense budget when combined. In an article posted by the Center for Strategic & International Studies:

> It is revealing that our distinction of acquisition categories (ACAT) is not principally based on the relative value or mission criticality but on how much money is expected to be spent—the most expensive programs are ACAT I, then ACAT II, then ACAT III. There isn't even a definitive accounting of the number of ACAT II and III programs, let alone their performance under current metrics or their relative national security value. It is highly likely that some ACAT II and III programs have greater military value than existing ACAT I programs. Yet, the allocation of investment funds, high-quality personnel, and Internet chatter inherently skews towards ACAT I programs simply because of our focus on dollars spent over value delivered. We must employ more relevant metrics of acquisition performance to get beyond our mundane and self-defeating rhetoric around defense spending. ("The Circular Firing Squad of Defense Acquisition Rhetoric," 2017)

EVM-Lite initiatives is one example of how defense programs could improve reliability of cost and reporting metrics by increasing the adoption of a standardized collection and reporting process.

The Department of Defense (DOD) has made great investments in EVM over the past ten years because of the benefits integrated performance management provides to the U.S. Government to acquire and manage a complex acquisition weapon systems. EVM is an industry proven tool to aid managers in making both initial program capital investment decisions and in assessing the cost, schedule and performance of ongoing programs. When implemented correctly, the DOD report to congress stated that EVM is the best program management tool available and no other alternatives exist that can match the benefits of EVM (OSD PARCA, 2009). A successful project is one that is managed with industry proven tools that combine elements of traditional and agile approaches to project management. There is an old saying that one should, "plan the work and work the plan." With a good cost and schedule baseline, a major delay or cost overrun should never be a surprise. There are always early indications of problems that should be visible and known to management if a good plan is in place to identify deviations. Overruns and delays will happen, but with good management, they can be mitigated so the impact is minimal.

ACAT II and III program thresholds are defined in Table 3. While ACAT II and III non-major programs are general less costly at the individual level, but combined make up a large percentage of the defense budget.

Table 3.   Description and Decision Authority for ACAT I-III Programs.
Source: DOD (2017).

ACAT	Reason for ACAT Designation	Decision Authority
ACAT I	Major defense acquisition program estimated to require an eventual total expenditure for research, development, test, and evaluation (RDT&E) of more than $480 million or, for procurement of more than $2.79 billion (in fiscal year 2014 dollars) for all increments Milestone decision authority designation	ACAT ID: DAE or as delegated ACAT IC: Head of the DOD Component or, if delegated, the CAE (not further delegable)
ACAT IA	Major automated information system (AIS) that is estimated to exceed: $40 million (in fiscal year 2014 dollars) for all expenditures directly related to the AIS definition, design, development, and deployment and incurred in a single fiscal year; or $165 million (in fiscal year 2014 dollars) for all expenditures directly related to the AIS definition, design, development, and deployment and incurred from the beginning of the materiel solution analysis phase through deployment at all sites; or $520 million (in fiscal year 2014 dollars) for all expenditures directly related to AIS definition, design, development, deployment, operations and maintenance, and incurred from the beginning of the materiel solution analysis phase through sustainment for the estimated useful life of the system Milestone decision authority designation	ACAT IAM: DAE or as delegated ACAT IAC: Head of the DOD Component or, if delegated, the CAE (not further delegable)
ACAT II	Does not meet criteria for ACAT I or IA Major system estimated to require an eventual total expenditure for RTD&E of more than $185 million, or for procurement of more than $835 million (in fiscal year 2014 dollars) Milestone decision authority designation	CAE or the individual designated by the CAE
ACAT III	Does not meet criteria for ACAT II or above An AIS program that is not a major AIS program	Designated by the CAE

Department of Defense (DOD) weapon system acquisition represents one of the largest areas of the federal government's discretionary spending. In fiscal year 2014, DOD requested $168 billion to develop, test, and acquire weapon systems and other products and equipment. About 40 percent of that total was for major defense acquisition programs (MDAP) or acquisition category (ACAT) I programs.1 The remaining approximately 60 percent of the budget request included, among other investments, funding for DOD's non-major ACAT II and III programs. (GAO, 2015)

Due to lower cost baselines for ACAT II and III programs, they typically require fewer reporting requirements with management oversight at the PEO levels. As a result, the insight into these programs from a cost and schedule perspective at the Office of Security of Defense or Congress level is often limited or non-existent.

C. PROBLEM STATEMENT

In the 2015, the GAO published a publication on *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* that illustrated the need for improved management as a result of "widespread data entry issues, missing data, and inconsistent identification of current ACAT II and III programs" (sec. 1). The GAO points out that DOD components' current efforts to improve ACAT II and III data are not addressing the problems holistically. The DOD provides no official policy or guidelines for using Earned Value Management (EVM) methods for programs that do not meet thresholds, resulting in a potential lack of measuring cost, schedule, and technical performance. As a direct impact, Project Managers (PM) may not understand how to sufficiently use industry standard program management tools or metrics to monitor contractor performance. Program Offices whom are ultimately responsible for managing Defense acquisition programs may not be able to make the best decisions possible. As a result, programs could be at greater risk of cost and schedule overruns that negatively affects every stakeholder. The GAO points out that defendable and timely cost, schedule, and performance data on smaller ACAT II and III programs is critical to ensure the DOD can report on how defense dollars are being spent and how well smaller programs are meeting critical objectives.

D. RESEARCH QUESTIONS

This research will conduct a comparative analysis on ACAT II and III programs to determine whether the use of EVM-Lite methods will provide ACAT II and III programs with the robust, cost effective, and tailorable tool kit for measuring project performance. Additionally, we will address the following questions:

1. What are the key issues related to data accuracy, completeness, or consistency with data received by the contractor to measure cost and schedule performance?

2. What training is necessary to address EVM gap capabilities in current training and certification programs?

3. How do ACAT II and III programs apply industry ANSI/EIA-748 EVM methods and software tools to improve on measuring project performance and progress?

4. How PM's can get the most out of the tools and analysis techniques to build an effective EVM approach?

E.   SCOPE OF PROJECT

The primary objective of this research is to demonstrate how EVM-Lite project management principles can be applicable for non-major programs that spend money within the DOD. The thesis will outline how and when to apply EVM-Lite principles to implement a successful program management strategy and when tailoring is important. This discussion will include a robust management implementation approach, data quality assessment, training plan, and information technology systems required to integrate cost and schedule data. The approach will allow for ease in tailoring to the extent that EVM concepts and tools are applied based on the cost benefit analysis done by the Program Office. The work relies heavily on the GAO report on *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* (GAO, 2015).

F.   METHODOLOGY

This research project was developed based on the problems identified in the GAO report on *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance on Non-Major Programs*. The Government Accountability Office report published a finding that Defense Acquisitions must "take steps to improve data

reliability and determine how to measure cost and schedule performance for non-major programs" (GAO, 2015).

This research hypothesizes that the principals and methodology of EVM can adapt fairly easily and cost effectively to fulfill the shortcomings GAO identified on non-major DOD programs. EVM forms (IPMR Formats 1–6 reports) and methods with tailoring provide a standardized reporting structure that can be utilized and stored in a centralized database. How to read and utilize EVM data and reports is widely instructed by the Defense Acquisition University (DAU) and Naval Postgraduate School (NPS) and can provide PMs with an integrated tool kit to manage projects. Additionally, EVM data can also provide cost and program data into a centralized acquisition portal data system that will significantly reduce the number of data entry issues and missing data for non-major programs. In summary, the advantages discussed throughout this thesis identifies tailored EVM-Lite methods and training approach that can fulfill the GAO needs within the existing DOD framework.

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II. LITERATURE REVIEW

A. GAO RESEARCH ON CURRENT STATE

In order to understand non-major programs and the issues they present within weapon system acquisition, this chapter conducts a literature review of Government Accountability Office's (GAO) March 2015 publication entitled *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* (GAO, 2015): "The U.S. Government Accountability Office (GAO) is an independent, nonpartisan agency that works for Congress. Often called the 'congressional watchdog,' GAO investigates how the federal government spends taxpayer dollars" ("About GAO," n.d.). GAO was tasked by the Committee on Armed Services, House of Representatives to examine non-major programs that fall within the Acquisition Category (ACAT) II and III designation criteria. This inquiry was based on the concern Congress has with these smaller programs and how they may create accountability issues. Based upon the logic that these programs are subject to less stringent reporting requirements and oversight. What makes this inquiry significant is the fact that currently ACAT II and III programs represent roughly 60 percent of weapon system acquisition spending (GAO, 2015). The following chapter reviews GAO's analysis of the current state of ACAT II and III programs.

GAO was tasked by the Committee on Armed Services, House of Representatives with the following:

- Determine the number of ACAT II and III programs (GAO, 2015).

- Determine selected programs total estimated acquisition costs (GAO, 2015).

- Determine selected programs cost and schedule performance and any factors that may be affecting them (GAO, 2015).

- Determine the number of ACAT II and III programs that might become major defense acquisition programs (MDAP) (GAO, 2015).

GAO answered the above questions by selecting weapon system acquisition programs from five DOD components: Army, Air Force, Navy, U.S. Special Operations Command (SOCOM), and the DOD Chemical and Biological Defense Program (CBDP) (GAO, 2015). These programs were selected based upon Department of Defense Directive 5000.1 definition of an acquisition program and DOD Instruction 5000.2 Acquisition Category criteria. First programs had to meet DODD 5000.2 definition of an acquisition program that describes "… as a directed, funded effort that provides a new, improved, or continuing materiel, weapon or information system, or service capability in response to an approved need" (Department of Defense [DOD], 2007, p. 2). Additionally, programs had to meet ACAT II or ACAT III criteria found within Department of Defense Instruction 5000.2 Acquisition Category Description for ACAT I-III programs.

Next, GAO selected programs based upon data found within component documentation to address program performance. Documentation included program acquisition documentation required during milestones reviews. For example, GAO analyzed component data to determine the number of ACAT II and III programs that might become major defense acquisition programs (MDAP), GAO screened programs that were within 10 percent or more of the ACAT I threshold criteria (GAO, 2015).

B. LESSONS LEARNED REGARDING THE LACK OF TOTAL COST AND PERFORMANCE ON ACAT II AND III PROGRAMS

Data provided was assessed by GAO to not meet accuracy and completeness thus making the data completely unreliable. GAO stated, "DOD components could not provide sufficiently reliable data for us to accurately determine the number, total cost, or performance of DOD's current ACAT II and III programs" (GAO, 2015, p. 6). The unreliability of the data was attributed to missing data, data entry problems, and inconsistent identification of ACAT II and III programs (GAO, 2015). GAO determined the data reliability problems, DOD's lack of performance metrics, and lack of baseline data has created large accountability limitations (GAO, 2015). For instance, data reliability made it difficult for components to recognize and report that five programs were near or over the ACAT I cost threshold (GAO, 2015). ACAT II and III programs do have Acquisition Program Baselines (APBs) that are reported in milestones and approved

by the MDA; the problem arises when the data is not archived or provided to GAO. Acquisition programs are required to present documentation for decision making and milestones reviews. Dependent upon the ACAT designation the level reporting requirements may defer per ACAT level. Table 4 describes acquisition reporting requirements as associated with ACAT level.

Table 4.   Applicability of Selected Acquisition Program Milestone Documentation Requirements by Acquisition Category (ACAT) Level. Source: GAO (2015).

Requirement	Description	Major defense acquisition	Major automated information	ACAT II	ACAT III
2366a/b Certification Memorandum	Certifies that certain acquisition process requirements have been fulfilled prior to milestone approval	✓			
Acquisition Program Baseline	Summarizes program cost, schedule, and performance parameters	✓	✓	✓	✓
Independent Cost Estimate	Program cost estimate completed outside of the supervision of the entity responsible for the acquisition program	✓	✓		
Requirements Documentation	Documents capability requirements to which the program responds	✓	✓	✓	✓
Systems Engineering Plan	Describes program's overall technical approach and details timing and criteria for technical	✓	✓	✓	✓
Technology Readiness Assessment	Assessment of the maturity of critical technologies and related risks	✓			
Test and Evaluation Master Plan	Primary planning and management tool for integrated test program	✓	✓	✓	✓

C.   RECOMMENDATIONS ON IMPROVING DATA RELIABILITY

As revealed in the 2015 publication *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* by the GAO that highlights four recommendations for executive action. GAO recommended that the Secretary of Defense direct the Under Secretary of Defense for Acquisition, Technology, and Logistics, in consultation with DOD components, to take the following actions:

- Establish guidelines on what constitutes a "current" ACAT II or III program for reporting purposes; the types of programs, if any, that do not require ACAT designations; and whether the rules for identifying current MDAPs would be appropriate for ACAT II and III programs; and

- Determine what metrics should be used and what data should be collected on ACAT II and III programs to measure cost and schedule performance; and whether the use of DAMIR and the MDAP selected acquisition report format may be appropriate for collecting data on ACAT II and III programs.

- [GAO recommends] that the Secretary of Defense direct the Secretaries of the Air Force, Army, and Navy and the Commander of SOCOM to take the following actions:

    o assess the reliability of data collected on ACAT II and III programs and work with PEOs to develop a strategy to improve procedures for the entry and maintenance of data; and

    o develop implementation plans to coordinate and execute component initiatives to improve data on ACAT II and III programs.

- [GAO also makes] two recommendations to help ensure compliance with relevant provisions of DOD acquisition policy with the purpose of improving DOD's ability to provide oversight for ACAT II and III programs, including those programs that may become MDAPs.

    o [GAO recommends] that the Secretary of Defense direct the Secretary of the Air Force and Commander of SOCOM to establish a mechanism to ensure compliance with APB requirements in DOD policy.

    o [GAO recommends] that the Secretary of Defense direct the Secretaries of the Air Force, Army, and Navy to improve component procedures for notifying the Defense Acquisition Executive of programs with a cost estimate within 10 percent of ACAT I cost thresholds. (GAO, 2015, p. 28–29)

D.   SUMMARY

GAO concluded that data unreliability made it impossible to answer Congress's questions. GAO suggested the DOD address the identified issues in order to gain accountability and manage programs effectively. After this report, the Army, Air Force, Navy, and U.S. Special Operations Command (SOCOM) programs have established information systems to address the reliability problems in response to the GAO report, while Chemical and Biological Defense Programs (CBDP) continue to determine the best path forward (GAO, 2015).

The GAO report did not specify the use of Earned Value Management methods as a solution to address the issues identified within the report. This JAP suggests that an EVM-Lite approach will assist programs to resolve problems found within the report. The issues faced by ACAT II and III programs suggest a need for a system to assist with data reliability and to assist in the management and supervision of the programs.

The process of using EVM at its heart, is all about establishing and reacting to an accurate, time-phased cost and schedule requirement. EVM is a sound, documented, processes that makes it a good application for improved project management. DOD programs that are allowed flexibility in tailoring the basic EVM concepts could help to control data reliability issues and improve management oversight. A sound EVM process would define what is being bought, how much it is going to cost, when are those costs due, what it actually costs, and how PMs measure if the project is going to need additional time or funding.

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III. ANALYSIS OF PROBLEM

A. LACK OF POLICY, REQUIREMENTS, OR EVEN BASIC GUIDANCE FOR NON-MAJOR PROGRAMS

Lack of guidance, poor traceability, and ineffectiveness in training continue to be the issues faced by PMs that are responsible for non-major programs. Currently, the DOD does not provide policy for collecting and reporting cost for non-major programs. The challenge to PMs is the lack of guidance and a centralized collection of cost, schedule or performance data for ACAT II and III programs. The lack of guidance results in concerns for DOD components about the reliability of the cost information provided by the contractor. While policy does not currently exist, DOD is looking to develop standards to collect reliable cost and performance data on non-major programs. ACAT II and III programs can benefit from new performance management reporting policies, however, DOD will need to use significantly more flexibility in the implementation policies for these smaller programs in order to make the data collection and reporting more cost effective and timely. To maintain cost effectiveness, policies would need to be revised to allow PMs to structure the cost collection levels and Work Breakdown Structures specific to their program needs. ACAT II and III programs may have different reporting requirements when compared to larger defense programs and cost of implementation must always be considered. Programs must perform a detailed cost assessment as a basic guidance to determine how much does a program need in terms of cost, schedule, and technical performance. Additionally, what will new requirements do to programs without adequate resources and can contractors comply with revised policies? The intent must always focus on how can PMs get the data quality they need to manage their real priorities while addressing the when, where, and how do we take on risk or mitigate risk with data and oversight.

B. TRACEABILITY/LEVEL OF DETAIL NECESSARY TO MANAGE WORK SCOPE

From an implementation stand-point, ACAT II and III programs do not have the traceability of work scope to contract budget. Without proper tractability, PMs could not

be assured that contractors have implemented a process to facilitate full integration of cost, schedule, and project performance objectives into a performance measurement baseline. The Work Breakdown Structure delineates product work packages at a level necessary to manage the scope of work. The Department of Defense MIL-STD-881C provides the definitions and framework for program WBS development. The Military Standard 881C is a good starting point for PMs to define their program's WBS into organized concepts. Programs must tailor the WBS to improve contract management down to the appropriate organizational levels where the scope of work occurs, that might be only one or two levels, depending on the size and complexity of the work, and oversight that is required. A well-designed WBS will ensure contract requirements are built into an integrated cost and schedule framework that can be used to evaluate program objectives (Humphrys & Associates, 2012). PMs should conduct and Integrated Baseline Review (IBR) within the early stages of a contract to "establishes a mutual understanding of the project performance measurement baseline" that provides "an agreement on a plan of action to evaluate the risks inherent in the program measurement baseline and the management processes that operate during project execution" ("Integrated Baseline Review (IBR)," 2017). According to the Defense Acquisition University AcqNotes website (n.d.), the IBR is an assessment that will review the technical content of the Performance Measurement Baseline to ensure it is consistent with the Statement of Work (SOW) and Contract Work Breakdown Structure (CWBS). Data traces will provide the ability for EVM analysts to cross-walk SOW requirements to discretely planned work packages. An IBR for ACAT II and III programs would be a much simpler affair than used on larger ACAT I Programs. The event would be held during a start of work meeting between key stakeholders involved in the contract and should not take more than a few hours. The current IBRs used on large, complex ACAT I programs can run into the millions of dollars and PMs need to limit the cost for small jobs to something achievable and affordable. The focus remains the same, a joint assessment between the government and contractor to assess the accuracy and realism of the IMS and PMB.

C. VARIANCE REPORTING IN DOD IS CONSIDERED A BAD THING

Variance Analysis provides the Government with fundamental cost and schedule insights for program execution progress and basic decision making. Variance Reporting is necessary in understanding the performance of teams, ensuring appropriate corrective actions are identified and completed, and allocation of resources make the most impact to the project. This process supports root-cause analysis and the conveying of the results upward. "When variance analysis is conducted properly (e.g., on time, and at the proper level), it can be an effective control against further cost and schedule problems that may jeopardize the successful completion of a project. Unfortunately, variance analysis can be untimely or excessive and even contribute to project failure by drawing project managers, engineers, and others away from more urgent problems" (Christensen, 1998, p. 4). The Joint Space Cost Council (JSCC), established by the Under Secretary of Defense for Acquisition, Technology, and Logistics and the Under Secretary of the Air Force conducted a study in 2013 on Reducing Industry Cost Impact to address better EVMS implementation. As reported in the study, the JSCC collected information on several space programs ranging in value from $20 million to more than $5 billion and focused on five major contractors including Ball Aerospace, Boeing, Northrop Grumman, Lockheed Martin and Raytheon (p. 7). The study also identified as a significant cost driver and administrative burden for contractors is the amount of Control Accounts (CA) and volume of reviews on government contracts. CAs size and number can significantly impact the administrative burden on the Control Account Managers (CAMs) and PMs by requiring a large number of Variance Analysis. As revealed in another 2015 DOD study, *Eliminating Requirements Imposed on Industry Where Costs Exceed Benefits* by D. Mark Husband and David J. Nicholls, contractors provided recommendations to reduce the administrative burden in that DOD implements EVM reporting (p. 57). The contractors proposed a simplified control account structure to reduce the amount of cost reports and variance analysis required on individual contracts ("Eliminating Requirements Imposed on Industry Where Costs Exceed Benefits," 2015). The attempt was to streamline the application of EVM policies and procedures to improve the efficiency of EVM implementation.

Variance reporting is generally considered as a non-essential administrative burden by the people having to write them. This is quite often technical personnel, such as engineers who believe they should be spending time fixing the problem instead of writing about it. The analysis feedback is part of their job and should help them to identify and manage the work. Additionally, CAMs forget that the majority of their audience is not aware of the details of the program and need the written report to be made aware of what is going on. CAMs and PMs are aware of the problems causing the variances and can speak at length about the problem. However, they do not want to be forced into writing concise and accurate descriptions, and may not want to be held to a written corrective action plan.

Many times, written variance analysis reporting thresholds can be too low and require more VARs than are really useful. To get around all of these problems and still have a written analysis when needed, you can look at some alternatives. Specifying written analysis on just the top three variances that exceed some predetermined dollar level (somewhat based on size and complexity of the project) is a good start. Also, PMs may require a verbal explanation at some regularly scheduled meeting, with a written variance only being required on variances that extended over some preset time period. For example, three months, or written if their corrective action is not put into place within the three months. Documented plans encourage contractors to provide and carry through on a corrective action. Combining a reasonable reporting threshold, with verbal reporting and then written reporting may make it more acceptable, and since there is no Program Assessment group using the variance reporting to develop their reports, the Government would have a lot more flexibility in what is chosen.

D. FLEXIBILITY NEEDED FOR WBS DEVELOPMENT IN ACAT II AND III PROGRAMS

A customized WBS for ACAT II and III programs is probably the most critical aspect of simplifying EVM planning and reporting. The WBS breaks down deliverables from the highest to lowest levels which organizes the team's work into manageable components. The document defines and displays the work to be produced as well as the

supporting activities needed to achieve the required end result. The WBS must be considered to satisfy SOW requirements. The hierarchical framework will provide the necessary coding for the system throughout the period of performance for the contract. The goal of the WBS is to have a traceable items between the systems used (PMB and IMS) for the life of the contract. The WBS is the means to integrate technical, schedule, cost and risk into a complete project management solution.

Many programs fail to use the same WBS for Program Management and cost estimating support. The lack of standardized reporting for program management and historical estimating support reduces confidence and credibility because it based on non-auditable data. Inconsistent reporting reduces insight into program cost needed to formulate budget plans and future cost estimates. Consistent cost reporting ensures all necessary requirements are included in the WBS. The WBS offers a comprehensive method for tracking cost data over time that provides Program Managers with a sound understanding of technical and programmatic data. Data can be broken down into parts to understand what elements affect the cost the most. Knowing what is driving the cost allows you to invest in the areas that will provide the "biggest bang for the buck." Program Managers that use consistent methods for program management and historical estimating support have defendable data with realistic baselines.

The WBS is intended for managing the project and historical estimating purposes, the flexibility is that it can be whatever the PM and stakeholders agree is sufficient to manage the project, while not being overly burdensome. For example, a sufficient WBS to manage a project on a $15 million program may be accomplished with a single point of responsibility pulling it all together. This may be accomplished with one WBS, with one control account and one work package. Every contract will be different and therefore, the WBS will be different.

The WBS development phase is a team activity in that the Program Manager will work with all stakeholders to define data elements at a level of detail that is commensurate with the size and complexity of the program. The team will ensure there is a direct correlation between WBS elements and the end deliverable. Having a well thought out WBS will help organize the work to be done through decomposition of the

program's scope into deliverables and then breaking those deliverables down into smaller components. In conjunction with the WBS development, the team will construct the WBS dictionary by documenting a brief definition of the scope, statement of work, defined deliverables, and associated activities planned throughout the project. At the completion of the WBS development phase, the Program Manager will have a well-defined WBS, WBS dictionary, and framework planned for measuring cost and schedule performance.

E.   EVM TRAINING APPROACH

In order to determine if the DODs EVM training program is effective for an EVM-Lite implementation approach one must first understand the training opportunities that are available to PMs. An official EVM Analyst job category currently does not exist in the DOD. Employees who are responsible for performing EVM data review and oversight hold the following position titles; Operation Research Analyst or Program Analyst. This section will highlight the training programs utilized by the DOD to prepare employees in performing EVM responsibilities.

1.   DAWIA

The Defense Acquisition Workforce Improvement Act (DAWIA) was enacted by the U.S. Congress on November 5, 1990. The DAWIA act was created for the Department of Defense (DOD) to more effectively develop and manage its Acquisition, Technology & Logistics (AT&L) Workforce. The DAWIA effort focuses on the qualifications and professionalism of the DOD's workforce by establishing education and training standards and requirements for the acquisition workforce. The DAWIA act required the DOD to create a formal training structure for their civilian and military employees. In Fiscal Year 2004 and 2005, DAWIA was amended to DAWIA II that provided more flexibility to the DOD that presented greater opportunities to the workforce ("DAWIA Transformation," n.d.). Currently, the DAU offers training programs that lead to DAWIA certifications in fourteen different career fields ("DAWIA Certification & Core Plus Development Guides," n.d.).

2. Defense Acquisition University

DAU is DODs corporate university offering acquisition, technology and logistics training to military and federal employees. DAU is an enterprise–wide training provider for many areas of defense acquisition, including EVM. DAU offers training courses through two main methods including web-enabled and classroom-based courses. These courses are designed around developing critical thinking skills. The web-enabled courses are set in a virtual classroom environment where students have to complete a series of modules. An exam at the end of each module is used to test the students' knowledge. Courses on average take twenty four to thirty hours to complete. Students must achieve 100 percent in each modules for a successful completion.

The classroom-based courses are taught by DAU facilities and range between three to ten days in duration. Students listen to lectures with hands-on group work to solve problem and issues they may encounter on the job. Students are required to give presentations that will help to gauge their progress. The minimum required score is 80 percent or higher on all assessments to successfully complete each class. DAU level one courses are computer based training modules that the student can take over the course of thirty days to complete. Level two and three courses are classroom-based where the student is required to pre-register to take at a later day and time. Depending on the course and student priority level the wait can be quite extensive.

DAU also offers Continuous Learning Modules (CLM). CLMs are computer based sessions similar to Level one courses. The main differences is CLMs focus on a specific topic and shorter in duration. Pre-requisites are not required and students can take them at any time when they need to refresh their skills. DAU also developed CLMs to assist employees in obtaining the required eighty hours of continuous learning every two years to maintain their career field certification.

Table 5 provides a list of the available DAU training courses that pertain to aspects of EVM. EVM 101 is the only mandatory EVM courses for DAWIA certification in Business Financial Management (BFM). EVM 202 and 263 are additional course options available for students. However, students are only required to take one EVM

level two course for BFM certification. It is recommended that employees take additional EVM courses, but they are not required to do so.

Table 5.   EVM Training Classes. Source: Defense Acquisition University, EVM Continuous Learning Modules (n.d.).

DAU EVM Training	
Course #	Title
EVM 101	Fundamentals of EVM
EVM 202	Intermediate EVM
EVM 262	EVMS Guidelines and Compliance
EVM 263	Principles of Schedule Management
CLV 016	Introduction to Earned Value Management
CLV 017	Performance Measurement Baseline
CLV 018	Earned Value and Financial Management Reports
CLV 019	Estimate at Completion
CLV 020	Baseline Maintenance

3.   DCMA

Like the Army, the DCMA uses the Defense Acquisition University for EVM training; however they also developed an additional set of courses that further enhances the training methods on cost, schedule and performance risk. Based on institutional knowledge, DCMA enhances the skills of EVM specialists by offering hands on surveillance experience at the contractor facilities. Table 6 provides a list of EVMS classes currently offered to DCMA employees.

Table 6. DCMA Training Courses. Source: DCMA Earned Value Management System (EVMS) Program Analysis Pamphlet (PAP) (2012).

DCMA EVM Training Courses
Course Title
EVMS Surveillance
Basic Scheduling Using Open Plan
Basic Scheduling Using Primavera
Contract Performance Report Analysis Using wInsight
Tripwires Training
EVMS Training Workshop
Schedule Risk Assessment Using Risk Plus
Critical Path Analysis
14-Poinit Assessment

4. OSD PARCA

OSD PARCA recommends using the DAU EVM training modules to familiarize DOD communities with the EVM process and the applicability to programs and contracts. OSD PARCA also publicizes a variety of resources on their website that is applicable for EVM tools, articles, training material and research libraries. OSD PARCA primarily focuses on policy and guidance and does not provide on-going training on implementation, analysis or validation methods. However, the OSD PARCA training team does provide a variety of opportunities to government and industry on EVM quality data assessments through data focus groups. EVM focus groups are semiannual large scale training events covering a wide range of topics related to EVM data quality and policy.

5. What Is Not Taught

Training is valuable, but only if the organization is doing it properly. PMs will be faced with challenges when implementing an EVM-Lite process for ACAT II and III

programs, due to the poor formalized training of EVM and ANSI/EIA-748. Quality EVM training from either DAU or other specialized institutions is difficult to find. This causes most professionals to learn through on-the-job training, if opportunities are available. Additionally, the existing DAU training does not teach the flexibility that is innate to the EVM framework. It is only after an analyst has been involved with different EVM implementations that they might start to understand the flexibility of the ANSI/EIA-748. The typical EVM system contains such a large amount of data that can be manipulated anyway the contractor desires, with little realization by the Government of what is being done. This lack of knowledge prevents analysts from tracking contractor performance accurately as well as validating whether it is being operated properly. The DAU curriculum is oriented toward teaching a high level understanding and analysis of EVM. The training lacks a hands-on approach to gain the practical knowledge necessary for a successful EVM-Lite initiative. The existing training philosophy is effective only if the managers using the information have well trained and experienced personnel that can understand, manage, and explain the details and anomalies that are part of an EVM System.

If DAU is unable to provide DOD programs with the necessary level of training, then PMs should consider working with public resources of higher learning to help formulate an EVM-Lite in-house training program. Students that complete a higher level of training would be able to design, implement, and operate a successful EVM-Lite process. Additionally, the student will be able to understand the EV data well enough to perform program validations. ACAT II and III programs without formal EVM will have to perform their own data validation process. Employees trained not only in EVM analysis, but also in EVM implementation and operation will help to ensure the accuracy of the data provided to the Government. Additional training is crucial for cost control and validating contractor performance. While DAU courses are believed to be strong contributors to PM knowledge and experience, training with specific examples, case studies, and best practices will help guide program resources to success.

F.   INEFFECTIVENESS IN TRAINING

As an EVM professional, the key to success is a comprehensive training program that provides a unique environment for effective defense project management. The Department of Defense uses the Defense Acquisition University (DAU) for the majority of their training needs. DAU training does not teach the flexibility that is part of EVMS or the necessary skills for data validation. Additionally, DAU does not provide different implementation methods that programs may use to develop a sound EVM-Lite process or how to understand the flexibility of ANSI/EIA-748. By not having good, formal hands-on training for EVM, particularly for Government Analysts, the PM really has little insight into the contractor's EVMS and whether it is being operated properly. Additionally, DCMA does not offer better training to provide the necessary contractor oversight. The typical EVM system on ACAT I programs contains a large amount of data that can be manipulated however the contractor desires, with little realization by the Government of what is being done. This drives the importance of data validation. Based on institutional knowledge, the only formal EVM training courses that are available to Army employees are offered by DAU courses, as presented in Table 5. PEO Combat Support & Combat Service Support (CSS&SS) and PEO Ground Combat Systems (GCS) Army organizations do not have an "in house" EVM training program that supplements the DAU training. In some cases, PMs have consulted with outside agencies to train employees on data validation, preparing a project for an Integrated Baseline Review (IBR), and software tools such as Cobra, wInsight and Open Plan.

The Army or DOD have not defined an EVM career path that supports program management principles and therefore reduces the opportunity for specific training requirements. Additionally, OSD PARCA does not recognize the need to have professional certifications in EVM. Based on institutional knowledge, PARCA believes there is not a sufficient population of students to pursue the necessary training through DAU. With no EVM career path or a formal incentive systems are in place, employees will lack the motivation to be proficient in this discipline and the organization will have a difficult time attracting and retaining qualified individuals in EVM positions ("Report to Congress on EVM," 2009).

DOD has been formally utilizing EVM longer than any other organization, closely followed by DOE. DOD and DOE have many forms and procedures that are used by commercial entities in their EVM System, even if formal compliance is not required. On September 1, 2009, DOD submitted a required *Report to Congress on Earned Value Management*. In the cover letter, DOD states that "after examining the topics identified in Section 887, the Department has concluded that the DOD EVM process is the best tool available to the program management community and senior leaders for effectively managing programs. The report identified that no other alternative exists that can match the benefits of EVM. Therefore, the Department is not pursuing any alternatives. Instead, it is focusing on improving EVM throughout the Department by implementing recommendations" ("Report to Congress on Earned Value Management," 2009). Within the report, it states that "during the 1990s period of acquisition reform and transition of EVM oversight from the Military Departments to DCMA, the Military Departments let their EVM expertise atrophy. Meanwhile, DCMA had not been adequately staffed to fulfill its responsibility to oversee contractor compliance. This lack of oversight led to a decline in attention to EVM within industry. With DCMA and the Military Departments lacking appropriate oversight capability, no one in the government was monitoring the quality of EVMS across industry. Now, the Department is attempting to rebuild its EVM competency. As a result, DOD and its contractors are both competing for a limited pool of knowledgeable EVM practitioners and are trying to develop methods for recreating the knowledge base" ("Report to Congress on Earned Value Management," 2009, p. 23)

Throughout the report, there are additional discussions about the lack of trained personnel available in both industry and government. However, there is no recommendation pertaining to expanded or improved training, or the need to identify a career path for individuals within EVM to encourage individuals to pursue the proper training. EVM professionals typically learn through on-the-job training. Analysts learn one way of doing EVM that works for their programs and assume all use the project information in the same manor. In a 2014 study on Department of Defense Program Manager Training and Experience, PMs describe the need for more "hands-on" practical training and "how to" best practices in dealing with acquisition cost growth. The study

recommended that training needs to include information on the causes of cost growth as well as skill development on how to avoid and minimize cost growth ("Department of Defense," 2014). Additionally, PMs expressed the need for more practical training in conducting comprehensive oversight of contractor performance. The majority of PMs repeatedly cited a need for greater content depth and more applications in cost control. Everything in the DOD system is oriented toward teaching a high level understanding and analysis of acquisition cost growth. PMs need greater depth and clarity, containing examples of conducting and using EVM applications to help avoid and minimize cost and schedule growth. By not having good, formal training on EVM, particularly for government analysts, the PM really has little insight into the contractor's process and whether it is being implemented and reported properly. PMs implementing cost controls methods for ACAT II and III programs need to have well trained and experienced personnel that can understand, manage, and explain the details and anomalies that are part of an EVM-Lite process. Understanding and using contractor reports require additional training and skill development for management, cost and schedule control. Performance Management is accomplished by using quality data to monitor contractor performance, manage risk and opportunities, and developing key metrics to identify causes of failures, and ways to avoid them. A deeper and more comprehensive training in industry operations, tailored wherever possible to the specific programs, will help to ensure analysts and PMs acquire the appropriate knowledge and experiences necessary for proficient management of ACAT II and III acquisition programs ("GAO Cost Estimating and Assessment Guide," 2009).

G. EVM CONCEPTS AND TOOLS APPROPRIATE FOR ACAT II AND III PROGRAMS

PMs must maintain their schedule and earned value data in project management tools to ensure accuracy and control of cost and schedule data. The Army's JLTV program developed and implemented an internal Integrated Management Tracking System (IMTS) combined with Integrated Critical Scheduling (ICS) using EVM concepts and tools to track test activities during the EMD phase. The testing performance metrics provided by the tool generated cost and schedule data used for collaborative discussions

between DOD test sites and the PM. The IMTS process combined with EVM metrics provided PMs with a comprehensive set of metrics and information to stay informed about progress and address issues and mitigate risks proactively. The IMTS established the integration and reporting standard operating procedures that provided a robust baseline to proactively measure test activities on prototype vehicles. The IMTS process documented advantages and pitfalls throughout process that provided PMs with corrective actions to improve the EMD phase. LTC Wolfgang Peterman, Product Manager (Former), Joint Light Tactical Vehicle (Army) stated that "the IMS process coupled with EVM enabled the PMO to have a leading indicator of contractor performance and implement mitigation steps where needed in a timely manner to keep the JLTV program on schedule and within budget" (JLTV Lessons Learned Information Briefing, 2011).

Earned Value analysts should take advantage of commercial off-the-shelf (COTS) EVM tools to view and analyze EVM-Lite submissions, perform data quality checks and performance tripwires, as well as to provide advance reporting and charting. COTS tools provide the best value to the Government because they are inexpensive and customizable to program needs right of the box. Industry standard EVM tools, such as Microsoft Project, Deltek Cobra, and Deltek wInsight can provide ACAT II and III PMs with detailed program performance in just a few clicks. Microsoft Project is an industry standard tool that can be used to maintain the Integrated Master Schedule. Deltek Cobra allows EVM analysts to directly import the project status for each control account and work package from Microsoft Project, ensuring alignment between the schedule data and cost data. Cobra is a very flexible tool that can fit most programs programmatic needs. Deltek wInsight can be used to take the EVM-Lite data from Cobra and populate charts, graphs, and tables for the project status reports. Deltek wInsight provides a flexible environment to display and distribute the data generated and maintained by the EVM-Lite database.

Project Management software delivers a flexible hierarchy that encourages the ability to filter information for fast and insightful data discovery. Tools such as Cobra and wInsight provides the Government with the ability to generate dashboards that have

customizable levels of detail and are drillable down to the lowest level possible. Having the ability to review and generate this level of information directly will not only enhance the Government's analysis ability, but it will reduce the contractor's support requirements. EVM analyst can generate reports internally, rather than requiring the contractor to generate and transmit, that will save time and money. A flexible and fully integrated set of software products will afford the PM with program performance information that can be shared with all project stakeholders. The information can be used to generate minimum, maximum, and most likely values that can be used to develop quantitative risk analysis that provides the confidence level of the forecast values, as well and funding needs for out-year requirements. Project management tools should be considered as part of the routine battle rhythm for generating monthly EVM-Lite performance and variance reports. The long term investment in project management tools will help PMs develop a structured process that provides full visibility and understanding of the status and health of their ACAT II and III programs.

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IV. DISCUSSION AND ANALYSIS

A. DATA ELEMENTS THAT ARE APPROPRIATE FOR A ROBUST, COST EFFECTIVE, AND TAILORABLE EVM-LITE TOOL KIT

Successful EVM-Lite processing and oversight requires not only an understanding of project management best practices, but requires in-depth experience in maintaining EVM Systems. In support of building a robust, cost effective toolkit, programs will need to provide a team of seasoned schedulers and EVM professionals with a breadth and depth of experience across many DOD organizations. A robust team will a comprehensive set of data from the contractor that includes: the Integrated Program Management Reports (IPMR), the IMS, Control Account/ Work Package performance extracts from programs such as Cobra and wInsight, Control Account Plans, Contract Funds Status Reports (CSFR), and inputs from IPTs to assess project performance, evaluate trends, identify risks, and make projections. Performance Measurement Baseline (PMB) analysis approach begins with collecting baseline programmatic and technical data. PMB is the time-phased budget plan under which, contract performance is measured. It consists of time-phased budgets at the work package level assigned to scheduled control accounts and budgets that have been assigned to individual product teams based on contractual requirements (Humphrys & Associates, 2012). Figure 3 provides the program life cycle for building, assessing, maintaining, performing, and learning from a successful EVM solution. This section further describes the key attributes required for measuring cost, schedule, and technical performance.

Figure 3.   EVM Life Cycle. Source: EVMS Interpretation Guide (2015).

The core principles for building an EVM-Lite tool-kit requires a thorough knowledge of the DOD EVMS Interpretation Guide ("EVMSIG," 2015) and EVM life cycle that includes:

- Build an Earned Value Management System. Provide assistance with the contractor and guidance in developing an implementation work plan. Work with key stakeholders to ensure a sound EVM-Lite structure and IMS approach is in place.

- Build Control Account Plans (CAPs). Support in reviewing CAP development for any program phase: RFP response, program kick-off, major replan, or major rolling wave planning. Help team choose proper Earned Value Techniques with Quantifiable Backup Data (QBD) as needed. Work with the team to validate vertical integration (i.e., WBS, SOW, IMP, and other codes properly).

- Build an Integrated Master Schedule. Participate in IMS development and validation to assure vertical and horizontal traceability in alignment with contract, deliverables, SOO/SOW, WBS, IMP, work authorization documents, and other key documents. Work with the team to assure IMS contains key handoffs and deliverables.

- Data Assessment. Provide guidance in analyzing and assessing EVM-Lite, IMS, and cost/schedule integrated data. Conduct independent assessments and provide recommended steps ("find and fix"). Help identify data anomalies and prioritize data cleanup actions based on significant magnitude.

- Schedule Risk Assessment (SRA). Provide programs with support in all phases of SRAs (IMS preparation, gathering three-point estimates, conducting SRA, and SRA follow-up). Review SRA outputs and provide recommendations regarding path forward. Support in incorporating risk mitigation and opportunity capture plans into the IMS.

- Prepare for and conduct an Integrated Baseline Review (IBR). Support in developing a strategy for successfully conducting the IBR. Work with team in preparing for an IBR, conducting an independent IBR with mock reviews and assessments. Provide support to Government CAMs during an IBR. Respond to IBR findings and develop corrective action plans.

- Prepare for Joint Surveillance Reviews (JSR) or Review for Cause (RFC). Develop a strategy and plan to prepare EVM-Lite and IMS data to

determine data reliability. Develop plan to address issues before JSR. Conduct regularly JSR throughout the contract period of performance. Provide follow up guidance regarding JSR corrective actions.

- Conduct VAR and ETC/EAC reviews. Conduct monthly reviews of contractor variance analysis reports and estimates at completion. Help Government CAMs improve VAR narratives. Help improve Format 5 narratives. Support team in improving VAR analysis techniques, including analyzing and explaining CPI versus To Complete Performance Indices (TCPI) deltas.

- Teach the EVM-Lite Life Cycle. Train the team with on-site training workshops and remote follow-on support to ensure knowledge transfer. Ensure knowledge transfers to the team with a train-the-trainers approach. Identify each stakeholder's position, background, interests, expectations requirements, influences, engagement, and commitment in order to maximize the successful completion of EVM-Lite objectives.

Program Managers may use these core principles defined in the EVM life cycle and Interpretation Guide to build a comprehensive process to gauge a contractor's progress against an agreed-upon PMB. PMs and stakeholders should review each principle and determine whether or not they apply to their program. These principles are flexible and every contract will be different and therefore, the implementation approach will be different. In summary, building a cost effective EVM-Lite toolkit requires a robust process that involves conducting interviews with subject matter experts between the Government and contractor to assess their existing capabilities with cost, schedule, and performance measurement (Director, Center for Earned Value Management, 2008). Building an integrated PMB process that encompasses all elements of the EVM life cycle will help identify risks early so they can be addressed before they become issues. Programs can structure a high level IBRs in an accelerated fashion, requiring the contractor to implement and lock down its cost and schedule baselines early in the program, subsequently offering the opportunity to find and fix problems before they

become significant issues. Program Management solutions combined with EVM principles will enable Program Managers to quickly understand performance and productivity issues of the overall contract or specific components of the work scope.

B. DATA RELIABILITY ISSUES FOR ACAT II AND III PROGRAMS

The GAO was unable to provide a thorough data reliability assessment on the population of current ACAT II and III programs. As previously discussed in Section II Literature Review, the reliably of data could not be determined based on the lack of documentation and reporting, including analyses of alternatives, cost-benefit trade-offs, risk management plans, and quality plans and metrics. The GAO reviewed 15 ACAT II and III programs based on data reported by each DOD component (GAO, 2015). The data provided by the contractor was unreliable for the GAO to accurately determine the total cost or performance for the programs reviewed. Data was lacking completeness, accuracy and DOD format consistency. The GAO also found a widespread issue related to baseline maintenance. Contractors did not follow a proper evaluation and maintenance of the cost performance baseline. The baseline was lacking a change control process that often resulted in scope creep and data integrity issues. As revealed in the 2015 publication *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* by the Government Accountability Office (GAO), DOD components' current efforts to improve ACAT II and III data are not addressing the inconsistency of contractor reporting holistically. The GAO points out that the DOD does not provide a standardized method for collecting and reporting cost, schedule, and performance data for ACAT II and III programs. Further, the publication noted "the lack of baseline cost and schedule data and comparable schedule milestones prevents DOD from consistently measuring the performance of ACAT II and III programs" (p. 6). Accordingly, the data issues noted by the GAO suggest that the lack of data on ACAT II and III programs limit the ability to provide oversight and effective decision-making. ACAT II and III-level programs continue to face challenges when balancing programmatic and operational requirements while executing and delivering prime mission products to warfighters. A well-prepared EVM process could offer ACAT II and

III programs with foundational tools that include a wide range of value-added management applications that will provide Program Managers with a robust cost and schedule management process.

C. PERFORMANCE MEASURES CURRENTLY USED BY PROJECT MANAGERS (PM)

The Government implements cost and schedule performance requirements on contracts to encourage good management and to help minimize risk. On most ACAT II and III contracts, the Government has limited risk due to the nature of contract types and therefore discourages an EVM requirement. However, this does not replace the need for a good project management process. ACAT II and III programs are still required to meet schedule objectives, while minimizing project risk and cost. Without clear, crisp goals, with integrated tools, PMs lack process efficiencies to effectively manage projects.

Based on institutional knowledge, most PMs on ACAT II and III programs receive cost burn rate reports and schedules to monitor contractor performance. In general, these reports and schedules are high level updates that monitor progress based on limited data provided by the contractor regarding the status of on-going work. Burn-rate assessments are reports that provide data on how the money was being spent, after the fact, and typically does not provide insight into program performance for future cost projections. "Today, most corporate financial executives measure the cost performance on projects using only two dimensions: the planned costs versus the actual costs. If all the allotted money is spent, they are right on target. If less was spent, then there is an underrun of costs; if more, then an overrun. This is not cost performance, but rather funding performance. What is missing is the value of the work performed for the money spent. This is called the earned value management" (Fleming & Koppelman, 2004). Burn rate reports are not an integrated performance solution to monitor cost, schedule, and technical baselines necessary to ensure realistic project reporting, analysis, and forecasting. Rather burn rate reports are funding reports that lack the ability to utilize historical data to validate forecasts necessary to generate independent Estimates-At-Completion (EACs) and running what-if scenarios. The challenge with contractor burn

rate reports is that they do not provide PMs with a sound understanding of what represents "true" cost performance. They lack an effective implementation approach in support of an integrated project management solution that can provide key stakeholders with timely and accurate contractor performance data. Program burn rate reports only provide a status in time and do not provide decision makers with visibility into technical, cost, schedule and risks on the project. A strong EVM-Lite capability and competency improves program decision making across the agency enabling PMs to address and mitigate cost and schedule growth. It allows key stakeholders to better justify and communicate positions through quantified data, especially when senior management has unrealistic project expectations. It also facilitates more realistic project schedules and budgets, with reserves necessary to deal with potential future issues, mitigating the probability of cost and schedule growth. The best managed programs and the most informed Program Managers demand the use of EVM metrics as an efficient project management tool for the "integration and measurement of cost, schedule and technical (scope) accomplishments" ("Earned Value Management," n.d.).

D.   SWOT ANALYSIS OF AN EVM-LITE PROCESS

EVM is program management technique used to establish and measure goals, expectations, milestones, metrics measurements. EVM provides an integrated method for planning, budgeting, project management and scope control. The advantage for using an EVM-Lite methodology for ACAT II and III programs is that the process will provide insight into program performance, while helping to control management risk necessary to meet program objectives. EVM methods can objectively measures project performance and help answer the question, "What are we going to get for the money we spend"? The objective for this section is analyze and discuss some of the strengths, weaknesses, opportunities and threats, also known as a S.W.O.T. analysis (Table 7) for the implementation of EVM-Lite techniques on ACAT II and III programs.

Table 7.   SWOT Analysis

	Helpful to Objective	Harmful to Objective
Internal Origin	**Strengths** ● High level of Program Efficiency ● Provides insight into True Program Performance ● Well-documented, and defendable cost and schedule data ● Integrated solution to improve contractor oversight ● Strong commitment to Mission ● Improve Organizational Efficiency ● Institutes a system to measure cost performance (BBP 2.0) ● Improve requirements tracking to minimize scope creep ● Ability to reuse a modified version of current EVM regulations and procedures ● Proved centralized meta data collection on all ACAT II and III program	**Weaknesses** ● Training ● Lack of defined processes for contractor oversight ● Shortages of Critical Staff ● Cost of implementing ● Contractors lack adequate resources ● Lack of appropriate training to achieve current and future objectives
External Origin	**Opportunities** ● High level of Program Efficiency ● Improved Cost Estimating and Budget Formulation ● Better approach for cost and performance of ACAT II and III programs ● Justify expanded EVM training ● Develop a job category with career path and opportunities for EVM Specialists ● Demonstrate how EVM could be used on internal Government projects (as is supposed to be done currently).	**Threats** ● Lack of acceptance by Organization ● Reduced Government funding ● Contractors technology ● Increased contractor oversight/burden ● Perceived cost of doing EVM

1.   Strengths

EVM principles on a project of any size provides PMs with an early indication that something may be wrong. By analyzing the various EVM-Lite metrics, PMs can identify and isolate problems so that they can develop corrective actions plans to help get the program back on track, or in worst case, show that the program might need to be restructured or cancelled before more money is spent. In essence, an integrated EVM process provides personnel with more reliable information to make better management decisions. By far, the greatest benefit that EVM principles can offer ACAT II and III PMs is the ability to manage a well-documented and defendable process using industry standard methods and tools. Through the use of good management practices, PMs can increase their probability of success. Scope creep can be controlled when key stakeholders are engaged because of the mutual agreement on how projects are measured. EVM principles establishes methodologies and plans that includes all stakeholders working towards a common goal. Additionally, both cost and schedule measures can be used to provide independent statistical high quality, reliable cost estimates that are comprehensive, well-documented, and defendable. Experience has shown these statistical estimates to be relatively accurate at a bottom line and provide an excellent check against PMs bottoms-up estimates that tend to be too optimistic.

2.   Weakness

EVM is a project management practice that offers PMs with many advantages, when properly applied. However, EVM practices also has its share of limitations. In order to be an effective cost performance metric, programs must validate that the data submitted by contractors is accurate and consistent, but not overstating performance. In order to properly validate, training is crucial to the success of an EVM-Lite implementation approach. Resources must be available in order to execute a sound EVM-Lite process for ACAT II and III programs. Another weakness of EVM is the perceived cost of implementing. The cost to develop an EVM-Lite process causes managers to try and avoid using it. The time required to collect and report performance data can be extensive for ACAT II and III programs operating on limited budgets and resources.

Additionally, many PMs consider EVM forecasts unreliable because they rely on past data to make projections about the future. PMs believe future performance does not necessarily depend on past performance. Another disadvantage is that EVM does not measure quality. Therefore, it is possible to have a project ahead of schedule and under budget, but still have unsuccessful results. Many contractors will avoid EVM-Lite initiatives based on a lack of experience or systems in place to effectively manage an automated data collection and analysis process. Additionally, contractors will downplay the importance of EVM that reduces the amount of attention placed on the process. EVM-Lite initiatives can only be successful when it becomes ingrained into the government and contractor's standard operating procedures.

3. Opportunities

While EVM provides an integrated solution for oversight, the largest opportunity for integrating an EVM-Lite process is to improve program efficiency. When implemented properly, EVM-Lite methods will capture sound program data that will help PMs successfully manage program execution. The robust process can provide PMs with corrective action plans if a project goes off track. The integrated cost methods will help to improve cost estimating and budget formulation while providing a standardized method for measuring cost and schedule performance. EVM standardized reporting methods and assessment tools will help to provide meaningful information that can be used to improve data reliability issues the GAO identified. The opportunities for ACAT II and III programs can demonstrate how effective EVM principles could be used on internal Government projects, regardless of the size. The positive elements demonstrated by a sound management process can identify the attractive factors that an organization can benefit from EVM principles while managing defense contracts. In addition to growing its benefits of improved program management, ACAT II and III programs have the opportunity to take advantage of the increased talent pool by improving training and career objectives. There would be no better opportunity than to recruit analysts from program job categories with career path and opportunities directly tied to EVM. They will have already been exposed to the culture and in a way, been trained in the way of doing things.

4.   Threats

The federal government is moving towards strict funding and policy uncertainty. The DOD anticipates further reduction in funding for programs to manage and execute projects. Therefore, methods like EVM-Lite strategies may never be successfully executed. Another threat to implementing an EVM-Lite methods is the perceived cost of doing EVM. Smaller contractors may lack the technology to successfully implement these strategies for developing an EVM portfolio that increases contract costs. An ongoing perception in the defense community is that EVM increases contractor oversight and burden. To maintain cost effectiveness, policies would need to be revised to allow PMs to structure and tailor these cost collection levels specific to their program needs. ACAT II and III programs have different reporting requirements when compared to larger defense programs and cost of implementation and the burden placed on contractors must always be considered.

E.   QUALITATIVE CHARACTERISTICS OF EVM-LITE

The risk analysis included in this discussion is a very powerful tool for both cost and scheduling planning. The risk analysis quality and accuracy of the results will be dependent on the level of the baseline being developed. For example, if an ACAT II and III program has a 500 line schedule and a 20 work package baseline, the results will be useful. However, if the program is not large enough to require more than a simple Gant chart and has WBS elements with one or two work packages, the risk analysis will provide little or no value. Smaller projects with limited planning is primarily oriented toward basic data collection, with limited amount of risk analysis. Therefore, this analysis will be based on a larger ACAT II or III program where the planning will still be fairly extensive and all of the discussed risk analysis may be useful.

Performance Measurement Baseline (PMB) analysis approach begins with collecting baseline programmatic and technical data. A Qualitative Analysis provides useful metrics about project cost and schedule risks to predict a level of confidence using statistical simulations to forecast project completion dates. The analysis is helpful for identifying high-priority risks and opportunities that can be used to determine the time

needed to maintain program confidence ("GAO Schedule Assessment Guide," 2012). Baseline assessments will be the foundation for the Schedule Risk Assessment (SRA) to determine how effectively risks are managed and what Lean Six Sigma methods and events need to be implemented to reduce process variances and increase efficiency. As the program baseline is created, it is important that boundary conditions are set to establish the parameters within that the program is expected to operate. Evaluations should be completed through a well-documented project baseline schedule. The schedule includes incorporating the project WBS and corresponding activities into the IMS, defining start and finish dates using earliest and latest start calculations. Activity durations estimations can be based on Monte Carlo outputs using historical information and expert judgment while employing schedule development techniques, like Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM). ACAT II and III programs must document and define risk and uncertainty by using project's risk information from sources like risk scorecard, risk assessment matrix, and risk register. Risk data can then be incorporated into the performance baseline using probability, distribution, and other statistical functions. Monte-Carlo methods can be used to simulate real project progress by generating multiple runs through the project cost and schedule baseline, assessing the impact of risk. Simulation runs can be used to calculate project durations and cost depending on its uncertainty profile. The schedule risk analysis output can be used to further define the measures necessary to control activities on the critical path. ("Schedule Risk Analysis: How to measure your baseline schedule's sensitivity," n.d.). According to the Schedule Risk Analysis article, the Qualitative Risk Analysis is based on ranking risks into descriptive categories. For example, QRA's can be based on a type of risk analysis program and input of budgets (Cobra Control Account or Work Package values) with a risk estimate and type of curve selected. The categories can be defined as low, medium, high; not important, important, very important and may be created and measured on a scale from 1 to 5. Analysts can run the method 1 or 1,000 times on the computer to come up with the risk spread using different values for each control account or work package. Based on specific statistics, the output provides at percent probability that the program you will spend by year, that will be extremely

helpful when formulating future budget estimates. The more input provided and relationships tied together, the more times you run the situation, the more accurate the results. There is still some opinion involved, but generally at a lower level of data the results are more defensible than just reporting a risk as Red, Yellow, or Green. Software is available that was originally developed by Booz Allen Hamilton for NASA, called Dynamic Integrated Cost Estimator (DICE). DICE features Integrated Cost & Schedule Risk Analysis, is an attempt to integrate cost and schedule risk analysis in a way that produces meaningful, compatible results.

Whether assessing or analyzing NASA, DOD, or Intelligence Community owned projects, the story is the same each time: Programs are increasingly experiencing growth above and beyond their initial cost and schedule estimates. Qualitative data increases the understanding of how schedule growth impacts cost. The data provides a robust distribution correlation, schedule logic functionality, and discrete risk integration characteristics. While qualitative data is important for program success, continuous training enhances the technical awareness that results in greater insight into Schedule Risk Assessments and comprehensive Estimate-At-Completions. EVM principles can be a complex integrated system that relies on strong WBSs, schedules, cost, and risk data. However, PMs should reinforce the importance of tailoring these EVM principles to their specific needs of the products being acquired to help avoid and minimize cost and schedule growth. Tailoring will help the team establish a sound process to track cost, schedule, and technical targets. PMs should base their methods of tailoring on the size and complexity of the work and where oversight is needed to minimize financial burdens. PMs may incorporate these disciplines in the training designed for the acquisition personnel to ensure success in the interpretation of EVM-Lite initiatives. The integration of cost and schedule analysis, combined with a well-trained EVM analyst, helps provide senior leadership with quality data to understand program status, recognize potential future impacts, and make critical program decisions.

F.   EVM-LITE CORE TRAINING COMPETENCIES

An Earned Value Management System (EVMS) consists of many parts. Each of the following areas need to be reviewed in order to fully understand the necessary skills required to implement an EVM-Lite process. Some of the areas can standalone, such as scheduling or risk management, but to become well rounded in project control concepts and capabilities, as well as for good project management practices, all of the parts should be thoroughly understood and integrated into an EVM-Lite process to effectively manage a project. The government analyst on ACAT II and III programs will have greater responsibly compared to EVM analysts on programs with fully compliant systems. This is a result for the need to validate that the EVM-Lite system meets program and procedural requirements. DCMA typically performs large program validations for system compliance. Table 8 lists competencies that should be considered for an EVM-Lite process.

Table 8.   EVM Core Competencies

EVM Core Competencies
Work Breakdown Structures (WBS)
Understanding and tailoring methods for ANSI/EIA-748 EVMS Criteria
Scheduling, Integrated Master Schedule, and Integrated Master Plan
Designing, Implementing, and Operating an EVM System for a project
Electronic integration of the resource loaded cost and schedule systems
Maintaining project baselines and reporting with Cobra
Forecasting in Project and Cobra
EVM Data Analysis and Reporting with wInsight
Variance Analysis
Change Control
EVM System Design consideration
IBR Preparation
Risk Management

EVM Core Competencies
Systems Engineering
Accounting
Federal Acquisition Regulations (FAR)
Understanding how DCMA supports EVM project/program requirements

EVM is an integral part of program management, and as such, it is an all-encompassing subject. An EVM analyst that has a sound understanding of the core competencies will possess the skills necessary to design, implement, and operate a comprehensive EVM-Lite system. The knowledge will provide analysts with the ability to make informed project management decisions. Additionally, all of this knowledge offers an excellent background for analysts to broaden experiences and seek opportunities to move into a senior project management position.

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V.   RECOMMENDATIONS

A.   ACAT II AND III IMPLEMENTATION OF EVM-LITE PRINCIPLES TO IMPROVE DATA ACCURACY, COMPLETENESS AND CONSISTENCY

ACAT II and III programs today face complex challenges when balancing programmatic and operational requirements, while executing and delivering prime mission products to warfighters. To be effective, EVM-Lite practices and competencies could improve PM Acquisition decision-making. A deep network of experienced subject matter experts (SME) and analysts are needed to implement and maintain a robust cost and schedule capability that will drive contractor accountability; afford current and predictive indicators of cost, schedule, and technical performance; and ensure contractors' compliance with industry best standards. EVM principles have proven knowledge of end-to-end program management best practices throughout all phases of the Acquisition Life Cycle, and experience with programs of varying size, scale, and complexity, including ACAT I Major Defense Acquisition Programs and Major Automated Information Systems. The ultimate goal of the implementation of EVM-Lite principles is to develop foundational programmatic processes and artifacts with the highest degree of rigor to enable effective planning, execution, analyses, and management and control—all of that are essential for delivering and maintaining compliance with an EVMS. Additionally, by having a well-defined process improves the collaboration between the clients and key stakeholders. PMs should look for ways to better institutionalize the EVM-Lite process by tailoring standards and formats for programs that do not meet DOD policy thresholds.

B.   APPLICATION OF IN-HOUSE EVM TRAINING PROGRAM

An Earned Value Management System (EVMS) consists of many parts, including Organization, Planning, Scheduling, Risk Management, and Budgeting. The principles of EVM must be learned in order to implement a successful EVM-Lite process. Some of the areas can be standalone, such as scheduling or risk management, but to become well rounded in project control concepts and capabilities, as well as for good project

management practices, all of these concepts should be thoroughly understood and integrated into an EVM-Lite process to effectively manage a project.

Table 9 is a list of subjects that would need to be considered for inclusion in an EVM-Lite in-house curriculum. Some of the areas would be combined into one class, and some might need to be expanded into multiple classes. EVM is an integral part of program management, and as such, it is an all-encompassing subject.

Table 9.   Proposed EVM Training Courses. Source: Integrated Project Management/Earned Value Management Handbook (2013).

Proposed EVM Training Courses	
Course #	Course Title
EVM 101	Introduction To EVMS
EVM 102	The Fire Triangle (Scope, Schedule, Budget)
EVM 103	ANSI/EIA-748 EVMS Criteria
EVM 104	Work Breakdown Structures
EVM 105	Scheduling, Integrated Master Schedule and Integrated Master Plan
EVM 106	EVM Baseline Development
EVM 107	Electronic Integration of Resource Loaded Cost and Schedule Systems
EVM 108	Multi-Project Baselines and Reporting With Cobra
EVM 109	Forecasting in Microsoft Project and Cobra
EVM 110	EVM Reporting
EVM 111	wInsight and Data Analysis
EVM 112	Variance Analysis
EVM 113	Change Control
EVM 114	Work Authorization Documentation
EVM 115	System Descriptions
EVM 116	Procedures
EVM 117	Material Control

Proposed EVM Training Courses	
EVM 118	Subcontract Management
EVM 119	EVM System Design Considerations
EVM 120	EVM and CMMI
EVM 121	CAM Training Support
EVM 122	IBR Preparation
EVM 123	DCMA EVM Support
EVM 124	Risk Management
EVM 125	Designing, Implementing and Operating an EVMS for a Project

1. Training for Management

Training for management requires a basic understanding of what EVM is and how to read and use the reports to help improve the likelihood of program success. Management training is necessary to drive home the importance of understanding and using EVM principles as part of a management tool kit for ACAT II and III programs. In order to truly understand EVM-Lite principles, management personnel with oversight responsibility need additional training to make sound investment decisions. Continuous training that focuses on the planning and execution of an EVM-Lite system that utilizes industry standard tools and methods in a disciplined manner will result in a project management control tool that balances cost, schedule and performance. If the control tool is incorporated properly throughout the life of a contract, then the output should result in significant cost savings to the government.

2. Training for EVM Analysts

Training for EVM analysts requires a high level of understanding and analysis of EVMS. Effective training and instruction will ensure analysts evaluating contractor data understands and recognizes the EVM-Lite metrics and performance trends that are evaluated each month. EVM experts need to be well equipped to implement EVM-Lite

best practices by mastering the tools and processes necessary to support effective project, cost, and schedule management. Proper training enhances the analyst's ability to understand program status, recognize potential future impacts, and make critical program decisions. EVM-Lite training will optimize efficiency by tailoring the necessary requirements that will help the team establish a sound process to track cost, schedule, and technical targets.

C. HOW TO APPLY ANSI/EIA-748 EVM METHODOLOGIES AND SOFTWARE TOOLS ON NON-MAJOR ACAT II AND III PROGRAMS

1. Implementation Approach

A good project schedule is one of the most important tools to have for good project management. There is an old saying that one should, "plan the work and work the plan." With a good schedule and cost baseline, a major delay or cost overrun should never be a surprise. There are always early indications of problems that should be visible and known to management if a good plan is in place to identify deviations. Overruns and delays will happen, but with good management, they can be mitigated so the impact is minimal.

In a formal EVM system, the baseline schedule is a controlled document, but the working schedule is a living document that will be changed and updated as the project moves forward in time and can do a better job of predicting and planning future work. A schedule is intended to help in the planning of the project, and subsequently identifying deviations and problems early enough to develop effective work-around solutions and implement them with a lower cost and schedule impact to the project. Generally, the more detailed the schedule, the sooner problems can be identified and mitigated. The schedule detail can be added after the baseline is locked in, so long as it is intended to support the controlled baseline and is not new work that needs to be added through an approved baseline change process. While more detail is generally good, too much detail can be overwhelming and expensive. The resources required to maintain an overly detailed schedule (or poorly constructed schedule) will not justify the increased

information available for analysis. The proper level of detail is different for every project, and there is no single way to say what is needed.

The baseline schedule should be developed prior to any significant amount of work being performed. The effort put into a good schedule will pay dividends throughout the life of a project. To accomplish this goal, this section seeks to provide the phases necessary for successful EVM-Lite implementation. Specifically, the sections aims to provide insight into how the existing methods used by PMs, with formal EVMS, can contribute to success in EVM-Lite implementations for ACAT II and III programs. However, tailoring the process is critical to ensure that the specific needs of the project will be addressed. Tailoring will help to reduce financial burdens to PMs and should be based on the size and complexity of the work and where oversight is needed.

Phase 1 – EVMS Support Prep and Gap Analysis

Begins with a gap analysis to review the contractors existing systems and processes. This determines what capabilities are present and what can be used to build upon to achieve a successful EVM-Lite process. Phase 1 includes program scope understanding and the appropriate flow of EVM-Lite requirements to prime contractors, subcontractors, vendors, and suppliers (as applicable). The gap analysis is performed through data collections (data call) and data analysis, including interviews with stakeholders and participants of the EVMS. The gap analysis typically follows the five sections of the 32 ANSI/EIA-748 guidelines such that all key and cross processes are considered. Table 10 provides the attributes of ANSI/EIA-748 and tailoring considerations for ACAT II and III programs.

Table 10.   ANSI/EIA-748 EVMS Tailoring.

EIA-748 Criteria	Attributes	Tailoring for ACAT II and III
Organization	Work Scope, Project Organization, subsidiary processes integration, and WBS and OBS integration	This would include limiting the WBS/OBS to only the elements required to measure performance. For example, one level WBS/OBS may be sufficient for a small, less-complex program. Additionally, MIL-STD-881C would not be required for all programs. A minimum WBS could be specified and defined by the contractor or the contract.
Planning, Scheduling and Budgeting	IMP/IMS, schedule measurement, PMB, cost element budgets, work and planning packages, LOE planning, Management Reserve, Undistributed Budget, and reconciling detailed planning to the CBB	Planning and scheduling only to the level necessary to manage the contract. Electronic integration may not be necessary for smaller ACAT II and III programs. Also, Level of Effort (LOE) planning may exceed the standard 20 percent limitation.
Accounting	Records direct costs by WBS and OBS, recording and allocating indirect costs, units and lot cost identification, and tracking and reporting material budgets and consumption.	Actuals will be accepted to the level of the contract and therefore program control accounts may be reported at a single level for smaller contracts.
Analysis and Management Reports	Calculating desired EV metrics, identifying and analyzing variances, implementing corrective actions, and maintaining a current EAC.	Reporting is limited to the amount of control accounts on a contract. Therefore, smaller, non-complex efforts may only report one data point in their analysis. The contractor will continue to report problems and corrective actions on high level reporting.
Revisions and Data Maintenance	Baseline change management and control, budget reconciliations, documenting PMB changes, and preventing unauthorized revisions.	The concepts remain the same regardless of the size of the program. However, a flatter WBS simplifies the contractor's burden of revisions and data maintenance.

Phase 2 – Establish Program Objectives

Performs an assessment of the contractors EVMS state and resources necessary to implement reporting requirements. The assessment includes developing and delivering a monthly EVM-Lite cadence routine, or sometimes referred to as a Battle Rhythm, to ensure the program covers every aspect of management during the month. The team will determine the manpower and training needed to maintain the monthly routine. Assessment of Control Account Manager (CAM) resources and support analysts are determined as well as IMS maintenance requirements for conducting schedule status and health assessments.

Tasks include: (1) Establish a program cadence to collect data monthly from Government and contractors, (2) Provide analytical support for the integration of actual costs and statistical forecasts (Estimates at Completion) into other elements of program planning and execution documentation, (3) Ensure alignment with requirements including the tailored EVM-Lite reports submitted to the Government includes the most recent budget submissions and contract changes to ensure the contractor is taking performance based on government directed activities and (4) Review the tailored EVM-Lite reports to ensure accurate data is being reported by the contractors. A tailored method may require a manual comparison of the schedule and cost data for smaller ACAT II and III programs. This may increase additional analysis requirements by the government's EVM analysts.

Phase 3 – EVM Data Quality Assessment

To evaluate the success of the EVM-Lite support, the team must provide a series of performance assessments to continuously evaluate project status that will encourage contractors to consistently perform at a higher level of operation. According to the PEO GCS 2016 EVM Quality Review Standard Operating Procedure, the quality assurance (QA) process maintains adequate assurance that the products, services, and processes in the project life cycle conforms to their specified process.

The DCMA EVMS Program Analysis Pamphlet (PAP) DCMA-EA PAM 200.1, DCMA defines Baseline quality as "a type of data integrity assessment that determines

the quality of the initial performance measurement baseline (PMB). The metrics indicate the amount of planning and forethought placed into the PMB" ("DCMA," 2012). While EVM-Lite initiatives on ACAT II and III programs do not require DCMA oversight, performing data quality assessments using DCMA's validation tools can be used to provide the highest level of quality management. EVM Analysts may use Qualitative Baseline Indicator assessments, action item resolution forms, and out brief risks and mitigation plans to determine the status of the contractor's Performance Measurement Baseline. This can be accomplished by investigating the quality, completeness, and adequacy during quarterly baseline reviews. Adverse impacts to the Baseline Indicator include: Incomplete baseline reviews; e.g., missing or fragmented cost, schedule, resource and management risks not addressed; baselines that do not capture the total scope of work; inadequate plan to address program risk; e.g., no logical burn down, hence high risk for cost increase and schedule delays as a result of lack of integration. Analysts will report findings and recommendations to the contractor through technical baseline reviews. Table 11 lists the QA activities that should be performed be considered during ACAT II and III technical baseline reviews to ensure the highest quality outcomes.

Table 11.   Quality Assurance Task Description. Source: PEO GCS EVM
               Quality Review Standard Operating Procedure (2016).

Quality Assurance Task	Quality Assurance Task Description
Define Goals, Objectives and Scope	The team will document all cost and schedule goals and objectives to confirm the scope of work to be performed.
Peer Reviews of Work Products	The team will leverage experts from internal peer reviews of all work products to the PEO/PM programs that will need cost and schedule control.
Adherence to Project Procedures	The team will ensure that all support activities adhere to the defined Project Management Procedures (if available) for the Project. This includes proper documentation and appropriate analysis of impact to cost, scope and schedule, as well as routing all baseline changes through a change control process.
Documentation of Corrective Actions, New Risks and Issues	The team will work with the Quality and Risk/Issue Managers to ensure that all new risks, issues, and corrective actions are captured and weighted accurately and then entered into the appropriate project management tool.

Phase – EVM Surveillance and Reviews

EVM-Lite validation review strategies include a major focus on corrective actions. The review of initial gap analysis, known issues or risks from the contractor project team, and known (or commonly found) issues by the customer are used to develop a Corrective Action Plans (CAP).

Before developing the CAP steps, the PM must investigate and determine root causes. Root cause analysis can help generate a CAP recovery for the program team. The CAP recovery includes concrete steps for clearing all known issues and non-compliance risks. Successful validation reviews depend on the ability to prioritize corrective actions to address the highest non-compliance issues and risks. Some corrective actions apply to systemic issues, while others are more targeted to a specific subsystem or to specific CAMs or Control Accounts. By targeting the specific project team members, one can quickly address issues to closure and demonstrate a proactive approach that will go a long way during surveillance reviews. The data quality review on smaller ACAT II and III

programs should not require a complex meeting. This may be conducted as a simple contractor to Government telephone review each month following data submittal. Data quality reviews may be incorporated into standard PM project management meetings already scheduled with the contractor.

2. Industry-Standard EVM Model ANSI/EIA-748 (32 Guidelines)

An ANSI/EIA Standard 748-C compliant EVMS Process employs the five EVMS categories and 32 guidelines. Table 12 highlights the five categories of an EVMS and consist of: 1) Organization, 2) Planning, Scheduling and Budgeting, 3) Accounting Considerations, 4) Analysis and Management Reporting, 5) Revisions and Data Maintenance. The technical approach to apply EVM-Lite support services overlays the ANSI/EIA Standard 748-C 32 guidelines to ensure programs will gain enriched program management data that is value added and enables the timely management of ACAT II and III programs.

Table 12.   Five EVMS Categories. Source: Earned Value Management Overview (n.d.)

Category One Organization	Category Two Planning, Scheduling, and Budgeting	Category Three Accounting Considerations	Category Four Analysis and Management Reporting	Category Five Revisions and Data Maintenance
Define WBS	Schedule Work	Summarize Costs in WBS/OBS	Determine Variances	Incorporate changes
Identify Stakeholders	Identify Products and Milestones	Perform Material Accounting	Set Variance Thresholds	Reconcile PMB
Integrate Systems		Validate PMB	Manage Corrective Action Plans	Control Retroactive Changes
Intensify Controls	Set time-phased budgets	Record Direct/ Indirect Costs		
Integrated WBS and OBS	Identify Significant Cost Elements		Perform Independent Estimate at	Approve Changes

Category One Organization	Category Two Planning, Scheduling, and Budgeting	Category Three Accounting Considerations	Category Four Analysis and Management Reporting	Category Five Revisions and Data Maintenance
Integrate IMS and PMB	Establish Work Packages Identify Risks and Establish Management Reserve (MR)		Complete Validate Data and Variances	Document PMB Revisions

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GUIDANCE
MIL-STD-881C Work Breakdown Structure for Defense Systems
IPMR Data Item Description (DID) DI-MGMT-81861
Project Management Institute (PMI) EVM Best Practices
Electronic Industries Alliance (EIA) Standard 748-C
DODI 5000.02 Operation of the Defense Acquisition Systems
DOD Earned Value Management System Implementation Guide (EVMSIG)
DCMA Earned Value Center of Excellence
OSD Performance Assessments and Root Cause Analyses (PARCA) EVM

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EVM fosters a project management environment that is rigorous and structured, addresses responsibility and accountability, and creates a sense of ownership in achieving planned results. The principles and tenets of EVM are sensible and sound, but developing and operating an EVM-Lite system from program inception to completion requires an overall process to measure trends in cost and schedule. The incorporation of the industry ANSI/EIA Standard 748-C is challenging and often underestimated for those who have never operated such a system. In order for ACAT II and III programs to realize the full promise and benefits of a cost and schedule integrated system, they will need to thoroughly understand EVM principles and the necessary steps for designing, implementing, and operating in a tailored environment. Programs that are well-versed with the DOD *Earned Value Management System Interpretation Guide* (EVMSIG) will

utilize it as part of the foundation of applying an EVM process. ACAT II and III programs can use the EVMSIG as a starting point to develop a performance measurement portfolio that will help achieve joint situational awareness for successful project management. The following section highlights each category of ANSI/EIA Standard 748-C and the suggested implementation approach that should be reviewed and considered during implementation assessments. While all areas may not be necessary depending on the size and complexity of the ACAT II and III program, each category provides a starting point of reference for developing an EVM-Lite framework.

a.   Category One–Organization (Guidelines 1–5)

During the initial stages of program planning, the PM will work with the contractor to understand their system capabilities. Part of the base understanding of their EVM-Lite reporting structure will be to ensure that the WBS is decomposed into manageable pieces and the OBS identifies the contractor resources and subcontractors performing the work. The structure will be reviewed to ensure that the OBS elements are linked to the appropriate WBS components. This will help ACAT II and III programs to prepare for a successful data review and eliminate risks and rework for both the contractor and the Government. The team will meet with program leaders, engineers, and staff to identify priorities and objectives. In conjunction with a good understanding of the current support activities and those that will be executed over the program duration, this review will serve as the basis for the development of the baseline planning assessment. The planning assessment will detail the activities to execute over the duration of the program, focus on critical dates for receiving information and distributing reports and analysis. The assessment plan should be updated periodically to incorporate process analysis and improvement.

b.   Category Two–Planning, Scheduling and Budgeting (Guidelines 6–15)

During the Planning, Scheduling, and Budgeting phase, the emphasis is on the contractor's plans for program cost, schedule, and technical objectives. The PM will aid the contractor in setting a reasonable and accurate PMB in conjunction with their IMS which, is integral to the development of the baseline. An accurate and reliable PMB is the

foundation for the reporting of cost and performance status to PMs. PMs must facilitate meetings in coordination with the Control Account Managers to compile the IMS. The project's goals and objectives must be verified in the IMS to ensure that the detailed work packages are sufficiently planned and planning packages provide the summary for future efforts (Humphrys & Associates, 2012). The work packages will show the critical milestones and the activities supporting those milestones. The IMS will include schedules from contractors as well as from the PM staff. The baseline will be established to include work packages for the near-term work under contract and planning packages for work further in the future. Through rolling-wave planning, the planning packages will be updated with more details to become work packages at major decision points in the project or when future contracts modifications are awarded. Starting with a robust IMS, the PM will work in partnership with the ACAT II and III System Engineers to execute the vision of its programs, apply sound management principles, and provide continuous insight into all activities associated with these projects. This approach applies rigorous project control processes and analysis for accurate information on project status and insightful forecasts. An integrated EVM solution incorporates the development and maintenance of the schedule baseline in Microsoft Project, and the development and maintenance of the PMB in Deltek Cobra. The basis of the integrated approach is guided by the framework of ANSI/EIA Standard 748-C and DI-MGMT-81861. Program Team Leads must define and explicitly break down the work into lower level components aligned with the WBS, continuously drilling down until each element has been analyzed. The components can be summarized and reintegrated into a baseline assessment plan that summarizes how the cost and schedule performance will be tracked (Humphrys & Associates, 2012). The components of work will align with the Control Accounts and be accompanied by a schedule with discrete milestones representing substantive work and a time-phased budget. Program Leads and the contractor must examine the project's requirement, obtain baseline data, and integrate it into the cost and schedule tracking tools. The program WBS must extend to the necessary level for management action and control based on the complexity of the ACAT II and III program.

c. Category Three–Accounting Considerations (Guidelines 16–21)

There must be a documented process and responsibility to manage and control contractor's costs. This will ensure that the direct and indirect costs associated with accomplishing the complete scope of work are properly transferred to the EVM process and summarized at the appropriate WBS and OBS levels consistent with the defined contractor's accounting process. This will ensure that the contractor's accounting process is reporting program cost data accurately for a valid comparison of budgets and performance, giving high confidence that the performance and variance analysis is accurate and reliable.

d. Category Four–Analysis and Management Reporting (Guidelines 22–27)

Detailed Analysis and Management Reporting will determine program variances, validate Estimates at Completion (EAC) and Estimates to Completion (ETC), and provide corrective action plans for management actions. Data analysis, forecast calculations, variance investigation, and corrective action plans will ensure strict adherence to the baseline. Analysis reporting may include Earned Schedule and Critical Path projections using SPI, CPI, and EAC to provide insightful status reporting.

e. Category Five–Revisions and Data Management (Guidelines 28–32)

EVM-Lite compliance will ensure that the contractor is maintaining an accurate and reliable Contract Budget Base and PMB throughout the contract. While validation is not required on EVM-Lite contracts, the contractor must still comply with industry standards. The PM must establish a formal change control process, including a baseline control log that will preserve the integrity of the PMB and corresponding EVMS. This will ensure that the PMB reflects the most current plan for accomplishing the effort and is providing dependable performance measurement data to all stakeholders.

3. Which Tool on the DAU Gold Card Is Appropriate to Use and When to Use it

The DAU Earned Value Management General Reference (n.d.) Gold Card is a reference card that breaks down the common EVM metrics and terminology that may be used by ACAT II and III programs. The Gold Card is an effective tool for evaluating overall program performance using industry standard controls and metrics. The Gold Card provides most of the common EVM terms and formulas. Program Managers on ACAT II and III programs can use the Gold Card to calculate monthly performance analysis to isolate and identify contract changes, Management Reserve (MR), EAC, Budget-At-Completion (BAC), and PMB schedule and cost variance drivers. The Gold Card is used to assess the adequacy of corrective actions and potential impacts to the program using industry standard performance metrics. The metric that is appropriate to use for tracking Cost and Schedule Performance trends are Cost Performance Index (CPI) and Schedule Performance Index (SPI) (3, 6, and 12 month as well as cumulative). Cumulative CPI is useful for determining the most likely and worst case limits for Estimate at Completion. To-Complete Performance Index (TCPI) is another useful metrics from the DAU Gold Card for evaluating the contractor's financial goals. Data generated from Gold Card metrics will form the programs impact analysis that includes predictions based on an execution and independent EAC to highlight areas that may impact critical program milestones or drive additional cost or schedule variances. The Gold Card allows you to integrate the metrics and projections from the schedule's critical path with the SPI, CPI, and EAC to provide insightful status reporting including dashboard reports at a level of detail appropriate for senior management. While it is easy to get overwhelmed by all the acronyms and metrics calculations, the DAU Gold Card is based on four simple concepts: "(1) How much you are planning for your project to cost at the end or the Budget at Complete (BAC), (2) How much you had planned to spend through today or the Planned Value (PV), (3) How much of the work, from a cost stand point, have you actually accomplished or Earned Value (EV) and (4) How much have you spent or Actual Cost (AC)" (Ten Six, 2016).

4.   How Effective Variance Analysis Can Improve Project Performance

As previously discussed, the Variance Analysis provided by the contractor is a critical part for tracking project performance. The program analyst ensures that all measures defined in the variance analysis meet the "SMART" objectives—they are Specific, Measurable, Actionable, Results-oriented, and Timely. In the past, DOD PMs approach for EVM implementations have fallen short of program expectations due to inadequate performance reports that did not have sufficient detail in the variance analysis report. Analyst on ACAT II and III programs must focus on the performance reports variance analysis narratives when reviewing contractor performance. All variances must be evaluated regardless if they are favorable or unfavorable. The analyst must thoroughly examine the variance report to determine if the overrun or underrun is concealing serious problems. Thresholds for variance reporting should be tailored based on the program objectives, risk and the criticality of the WBS elements. Thresholds should be reviewed regularly to determine if the variance analysis report is providing sufficient data to evaluate the status of the program ("NASA EVM Analysis," n.d.).

Variance Analysis must sufficiently addresses variance identification, program impacts, and corrective actions while being written at an appropriate WBS level that provides the PM with the visibility it requires. The Variance Analysis report process must provide a checklist for preparing a report to successfully review cost and schedule variances. The structured steps in preparing a Variance Analysis Reporting (VAR) include, but are not limited to:

- Collecting technical, schedule and cost data

- Validating the information

- Clearly defining the problem

- Determining the cause of the problem (root cause)

- Addressing the technical, schedule, cost impacts to other work scope elements in the project

- Developing a corrective action plan (CAP) to mitigate, eliminate or offset the problem

- Analyzing impacts to the Estimate to Complete (ETC) and the Estimate at Completion (EAC)

- Implementing and tracking the corrective actions

- Monitoring and revising the corrective actions, as needed. (Hyde & Watenpaugh, 2015)

D. EVM TOOLS TO IMPROVE TRACKING PERFORMANCE, COST ANALYSIS, AND REPORTING

1. Deltek Software Tools to Populate Dashboards, Charts, Graphs, and Tables

EVM-Lite principles on ACAT II and III programs do not require the use of specific cost or scheduling software. A perfectly valid system can be operated using excel spreadsheets alongside Microsoft Project. However, using good software makes it easier and more useful to PMs. Currently, DOD expects, if not mandated in the contract, that a contractor will have software to manage scheduling and budgeting, and that the systems will be electronically integrated. Although many DOD contractors already do this analysts will need to closely examine all of the documentation to ensure that budgets and dates match precisely between the cost and schedule system. ACAT II and III programs will not have DCMA oversight. Therefore, PMs will need to assign resources to conduct data validations. To assist in validations efforts PMs may use software tools to help automate the process. Deltek is one of the leading providers of EVM software within industry. Deltek Cobra allows one to directly import the project status for each control account and work package from the Microsoft Project schedule on a monthly basis, ensuring alignment between the schedule and cost data. Deltek Cobra can load and track the actual project costs at the control account level, while reporting at a higher level. Deltek wInsight can be used to take the EVM data from Cobra and populate charts, graphs, and tables for the project status reports. wInsight's flexible environment allows Program Analysts to display and distribute the data generated and maintained by Cobra with a click of a button. Figure 4 demonstrates a customizable dashboard reports that can be provided by Deltek wInsight.
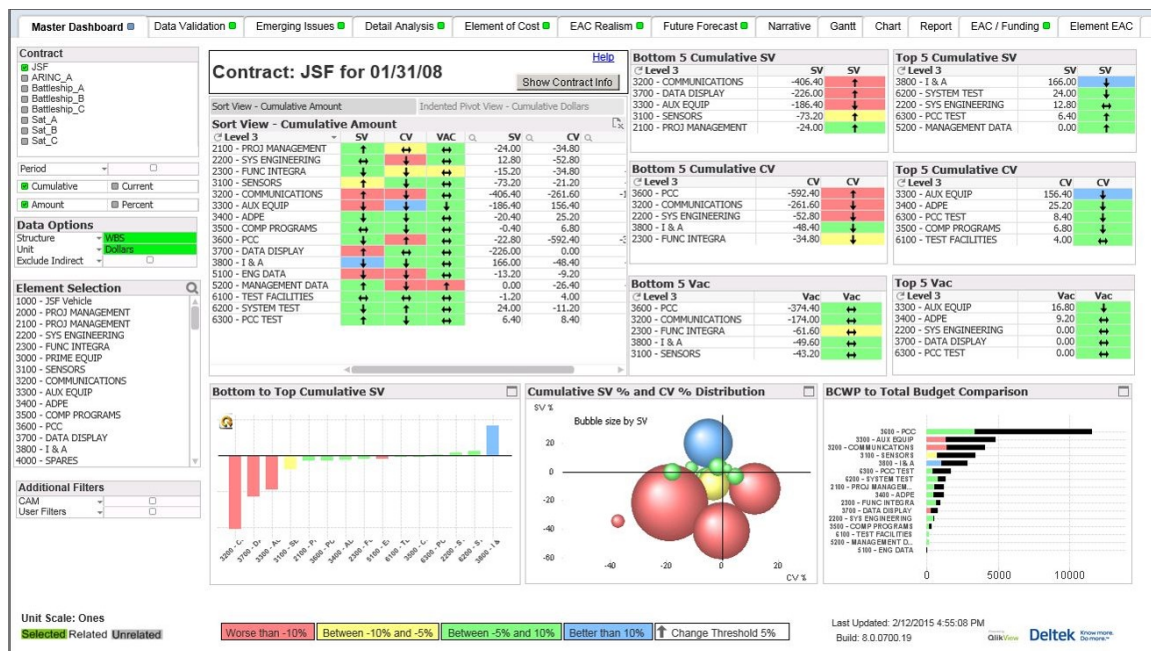
Figure 4.   Deltek wInsight. Source: Ten Six Consulting, https://tensix.com/2014/05/
deltek-releases-winsight-analytics-7-0.

Program Offices can seamlessly analyze cost and integrate earned value performance into their management processes by using commercial off-the-shelf products such as Deltek wInsight, Cobra and Microsoft Project.

2.   Using Deltek Cobra to Improve Tracking, Cost Analysis, and Reporting

Due to the increased demand from contractors, the DOD is placing extreme pressure on industry to provide quality data. The increased oversight and government mandated requirements for EVM, Cost and Software Data Reporting (CSDR) and the most recent initiative Cost and Hour Report (FlexFile) have now required contractors to meet strict reporting requirements. ACAT II and III programs will be faced with significant challenges to meet DODs increased demand for cost and schedule reporting without the right software tools in place ("Why Deltek Cobra?," n.d.). Deltek Cobra is a best in class EVM tool that is available in the market today. Cobra is a powerful enterprise solution for managing project costs and measuring earned value performance. Cobra is the center of most large contractors finance and project scheduling system.

Figure 5 shows how Deltek Cobra is part of the contractors' common business elements of EVMS.
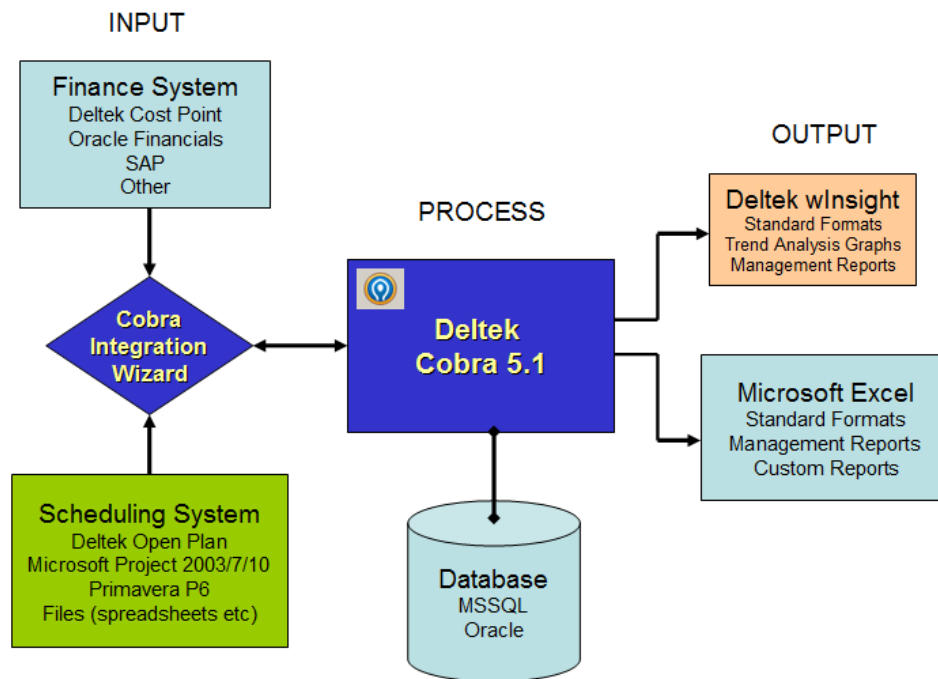

Figure 5.   Deltek Cobra Contractor Elements. Source: Ten Six Consulting, https://tensix.com/2012/03/getting-to-know-deltek-cobra-5-1.

Cobra is based on a relational databases that is very flexible and offer almost unlimited combinations in setting up and managing small to large projects. Cobra integration wizard allows the software to integrate with most project management and finance systems used in the market today. Cobra is available as a cloud or client solution that can reduce operational costs by building an enterprise solution. Cobra's comprehensive set of tools offers improved cost collection and forecasting to enhance data reporting. The application provides access to program information, including labor hours and staffing requirements as well as detailed project cost elements that can be used to build a competitive strategy for future contracts ("Why Deltek Cobra?," n.d.).

Defense contractors typically use Deltek Cobra project management software for managing cost performance. The Government can improve their ability to see problems

are trends by obtaining electronic backups of Cobra data. Additionally, requesting the contractor to resource load their schedule and electronically integrate the schedule with Cobra is the first step in improved management and reporting. Cobra data feeds into the need for a greater level of information visibility that is currently available today. Resource loading the schedule and electronic integration creates a baseline that is directly traceable to the schedule. The baseline budget values are directly traceable to the schedule since all direct hours and dollars come from the schedule. When combined with Cobra, the Government is provided with an improved system to review, as well as insight into the expected type and quantity of resources (labor hours, materials, and subcontracts) that the contractor expects to utilize in performing the work. Tracking the resources at this level of detail enhances the Government's ability to negotiate future contact modifications, since programs can see what was planned against a baseline that shows the changes over the life of the project. When properly set up, the electronic integration eliminates a significant amount of dual entry and errors. The Cobra Integration Wizard looks at the coding for all schedule activities with the same work package identification, assigns the earliest early start and the latest early finish from the schedule to the work package time span. The wizard can also utilize the contractor's accounting calendar to pull the rolled up resources by the proper accounting periods and summarize and price the resources out in Cobra. This results in Cobra work package budgets matching the resources in total and by accounting periods, with the resource contained in the schedule. Contractors can have as much detail as they need in the schedule and the Wizard will summarize to the identified work package.

The wizard allows contractors to connect Cobra to virtually any accounting or schedule system they currently have in place. This simplifies reporting, since the schedule will be the objective evidence of the work performance, and the work package will represent the summarized data where actual cost information is collected. Once the integration is setup, the same linkage is used to collect monthly schedule status that is integrated into Cobra, as well as updated forecasts of future costs. Since the contractor will identify their Performance Measurement Technique (PMT) within the schedule for each activity (i.e., 50/50, 0/100, percent complete), this will roll up to a summarized

status at the work package level of the schedule that will match with the percent complete shown in the work package. Any performance differences shown in the data will be tracked back to the schedule, rather than trying to hold the same level of detail in the baseline.

Good business practice dictates that the contractor performs regular backups of their Cobra database. This is normally done at the end of each accounting period to hold the data that is reported to the Government in the IMS and Performance Management Report. Requesting copies of the contractor backups does not require any additional work beyond attaching to an email (backups are in a zip file) or including the files in a central repository. If ACAT II and III PMs request systems backups, they will have the database information at the same level of detail the contractor works with to review, analyze, print, and distribute the information to the appropriate personnel. Cobra holds all data in time phased records that are tied to the specific accounting period, control account, work package, resource, and cost classes that make up a work package. Program Analysts can develop a standardized report format that can be used to train and inform all Government IPTs. The increased benefits to analyze data that is time phased and available by element of cost significantly enhances the PMs ability to forecast impacts and even perform quantitative risk analysis. When forecasting impacts program performance, direct labor generally behaves differently than materials. Subcontracts vary with contracts that are labor augmentation versus deliverable based. Seeing this level of detail within the work package enables the Government to perform independent analysis and forecasting, rather than just accepting what the contractor provides in the traditional reporting format. Too often, the contractors do not make effective use of their own information, and our ability to effectively review the data will allow the Government to help the contractor to manage better by identifying problems and trends early enough that effectively control cost and provide opportunities to develop timely work-arounds. When a schedule variance is identified in the EVM-Lite system, analysts will not only be looking at the activities that created the schedule variance, but at subsequent activities to see the impact, and if relationships are properly identified. Cost variances will still be identified in the contractor's baseline, but will have improved confidence that the work and the costs are

being measured against is identified within the schedule. If there is a schedule variance, when PMs are looking at the activities creating the variance, the schedule should also have the current plan for the activities to work around to fix the problem. Electronic backups of Cobra should enhance the Government IPTs involvement in EVM-Lite principles and reduce the contractor's special reporting requirements.

Limiting the information supplied to the IPT's area of responsibility will help to drive project efficiency. IPTs that focus specifically on work package level of information, the resource by labor, materials, and subcontract, and the time phased BCWS for only a six month window will have greater visibility into their work scope. Tailoring performance data will provide IPTs with more information than available now, but in a small enough package to highlight where they should focus their attention. With the electronic backups loaded in the software, PMs will be able to include filters on the information to print out only the information they want to distribute to each IPT Lead. The IPTs generally do not have the time to look at large reports where only a small portion actually pertains to them. Cobra can provide filtering on the cost elements that provides IPTs with the cost and schedule information that matches with the data they are interested in reviewing.

Another benefit for using Cobra is the PM's cost community will generally have more information available to them that is currently available through the CSDR process, if available on their program. Since Cobra is where most contractors will develop and store CSDR data, cost analysts will have everything they provide in the CSDR reports, and more. Access to work package information when reviewing CSDR information enables more accurate identification of recurring and non-recurring costs than is available through the CSDR forms and the IPMR. Cost Analysts will be able to identify data problems and questions before reports are submitted, resulting in improved efficiency. Having the ability to review and generate lower level of information directly will not only enhance the Government's analysis ability, but it should reduce the contractor's support requirements, since the Government will no longer have to request it. The Government can generate the reports internally, rather than requiring the contractor to generate and transmit the report that will save time and provide analysts with the ability to get what

they want and be able to modify, as necessary. This will also provide PMs the information they need to generate minimum, maximum, and most likely values for each control account, and from there develop quantitative risk analysis that provides the confidence level of the forecast values, as well and future funding needs. Cobra, with minor modifications, allows cost analysts to filter Work Package data by Cost Element Structures (CES). As revealed in the 2002 *Department of the Army, Cost Analysis Manual*, the goal of CES is to provide a "consistent preparation and documentation of cost estimates by using uniform cost structures with standardized elements and definitions" (p. 49). The manual further noted that the CES "incorporates all aspects of the program WBS Level 2 support elements, such as system engineering/program management, training, data, and peculiar support equipment" (p. 50). As noted, the advantage for CES coding is to support future cost estimating with the alignment of data elements that closely supports the PPBES process. Integrating Cobra with CES provides PMs with the ability to filter on cost elements by labor, materials, and subcontract, time-phased recurring and non-recurring costs.

Earned Schedule analysis using Critical Path work packages is another benefit to using Cobra on ACAT II and III programs. Analysts can code work packages in Cobra to determine project status using the Earned Schedule methodology. The Earned Schedule chart uses EVM data to forecast schedule delays in calendar days to complement the analysis. The problem with traditional schedule metrics is they are intrinsic to EVM metrics for later performing project. Traditional metrics did not provide PMs with the information necessary to mitigate the risk of delayed dates or exhausting project budgets. Earned schedule complimented standard EVM metrics because Schedule Indicators fail for later performing projects. Schedule Variance (SV) and SPI behave erratically for projects behind schedule. In traditional EVM, a project would appear to be on schedule with an SV of 0 or an SPI of 1.0 (Lukas, 2008). However, the metrics alone do not show that the project was behind schedule and delivered late (see Figure 6). Earned Schedule on critical path activities is much more indicative of true schedule status. While bottom line CPI works, because over-performing and under-performing account dollars do balance each other, the bottom line SPI is not a true indicator of schedule delays because

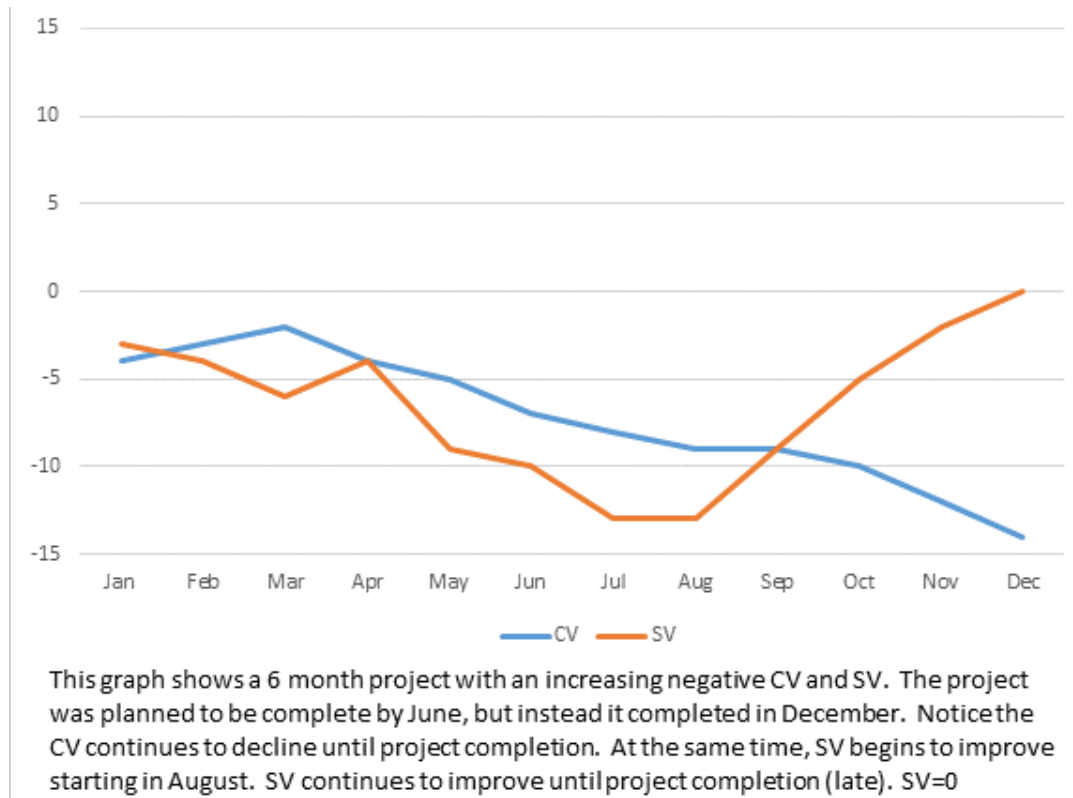over performing work, or LOE work does not balance out time for underperforming critical path activities.

This graph shows a 6 month project with an increasing negative CV and SV. The project was planned to be complete by June, but instead it completed in December. Notice the CV continues to decline until project completion. At the same time, SV begins to improve starting in August. SV continues to improve until project completion (late). SV=0

Figure 6.   Late Delivered Schedule

Data anomalies can manifest when a program is near 65 percent project completion, meaning traditional EVM "schedule metrics lose their predictive ability over the last third of project" (Lipke, 2007). The Earned Schedule metric retains utility to project completion as it does not automatically return to 1.0. Earned Schedule Indicators are cost-based instead of time-based and can be applied to the total program or critical path work packages to track or validate project performance. The methodology allows schedule-based metrics to be defined in time units and cost based metrics. This is far easier to understand than quantifying time in currency, e.g., the project is $200,000 thousand behind schedule and $50,000 thousand over budget" versus the project is 28 days behind schedule and $50,000 thousand over budget.

E. COST AND BENEFIT OF THE EARNED VALUE MANAGEMENT PROCESS

1. Better Stewardship of Taxpayer Money

As revealed in the 2015 publication *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* by the Government Accountability Office (GAO), Non-Special Interest ACAT II and III programs generally do not follow Cost Estimating Best Practices. The GAO report further noted "these programs relied heavily on overly optimistic cost assumptions and failed to adequately account for risk and uncertainty" (p. 21). ACAT II and III programs need to make improvements to enable government data collection methods. EVM-Lite initiatives is one example on how to improve reliability of cost data by increasing the adoption of a standardized collection and reporting methods. This approach will formalize a cost planning and performance model by using industry standard tools that will provide DOD decision makers with program specific data that will aid in informed decision making. Traditional EVM data will record and track program performance opposed to strategic objectives. Defense programs as customers of the acquisition process are "responsible for balancing resources against priorities on the acquisition program and ensuring that appropriate trade-offs are made among cost, schedule, technical feasibility, and performance" (Davis, 2015). EVM-Lite principles can provide programs with the framework to collect and evaluate cost and schedule data for all DOD operational programs. The overall goal is to objectively tie cost execution to technical output promoting informed management decisions making and improved program estimating.

2. Worth the Cost

As revealed in the 1998 publication on *The Costs and Benefits of the Earned Value Management Process* by Dr. David S. Christensen, "the normal costs of operating a management control system are not considered relevant because they would be incurred in the absence of any requirement for an earned value management system" (p. 6). A DOD study performed by the Joint Space Cost Council (JSCC) on *Better EVMS Implementation* have shown that many (if not all) large engineering companies use

modified versions of EVM to manage their projects that means it is not just a Government requirement. The JSCC found after an examination of major acquisitions programs that every prime contractor had an internal EVM process they used to manage in-house Government efforts. If such an internal effort existed, why does formal EVM cost so much? According to Dr. David S. Christensen's 1998 publication on *The Costs and Benefits of the Earned Value Management Process*, high "EVMS costs were in the areas of Engineering/Program Management (65 percent) and Finance (25 percent)" (p. 6). During his research, he determined that program managers were responsible for managing and controlling the entire system while the engineers were responsible for analysis and variance reporting. He further noted that the finance team ensured compliance with the EVMS criteria. Dr. David S. Christiansen went on to discuss additional cost associated with preparing written variance reports at detailed levels within the work breakdown structure. However, many defense contractors argued that the majority of the cost premium resulted from excessive requirements that stemmed from DCMA oversight and validations efforts. Dr. David S. Christiansen revealed that as a result of extensive validation efforts the cost and benefits of EVMS ranged between 0.1 percent and 5 percent of the contract value.

Based on analysis of defense contractors conducted by Coopers & Lybrand and TASC (C&L/TASC) indicated that on a $100 million contract, $60 million (60 percent) would be value added, $10.8 million (18 percent of $60 million) would be the regulatory premium, and $0.54 million (0.9 percent of $60 million) would be the regulatory cost of EVMS to industry (Christensen, 1998, p. 6). As reported in the 1998 publication on *The Costs and Benefits of the Earned Value Management Process* by Dr. David S. Christensen, "EVM-based costing was ranked third among the top ten cost drivers, and was estimated to be about 0.9 percent of the value added costs to programs" (p. 6). In order to define the true costs of an EVM implementation, programs must understand the underlying costs associated with it. Program Analysts also need to define the benefits that EVM principles can provide to the government. If contractors rely on an internal EVMS process for government type efforts, then ACAT II and III programs should consider applying these initiatives as well. In a Firm Fixed Price (FFP) environment the benefit to

track and manage cost and schedule performance is on the contractor that assumed the risk. However, the Government can also benefit from an internal EVMS process by keeping the project on track, while reducing risk.

The most significant long range cost savings method for an EVM-Lite process is reporting that is based on a higher WBS level structure rather than demanding an enormous amount of lower level control accounts. A large number of control accounts required on a program increases the reporting cost details, including variance analysis and Estimates at Completion (EAC). Variance thresholds must always be considered when implementing an EVM-Lite process to minimize the administrative burden of reporting. The reporting structure must leverage streamlining efforts in order to remain cost effective for ACAT II and IIIs. Short range savings can result from modifying the expectations for an Integrated Baseline Review (IBR). Having a two hour meeting to go over expectations is much cheaper than a three day IBR with associated training and preparations that can cost a couple of million on a $300 million project.

An introduction of EVM-Lite solution can be worth the cost if the requirements would be tailorable to the size and needs of a project. ACAT II and III programs would not generally be full EVM compliance, but would provide opportunities to implement an integrated project management solution. EVM principles offer a lot of information in a time phased standard format that highlights the plan, actuals, and forecast, to be used in budgeting planning, program execution and what-if drills. EVM-Lite, if implemented with tailored methods, should not be any appreciable increase in cost over what is done now, but will standardize the reporting process and be able to address concerns identified by the GAO report *Defense Acquisitions – Better Approach Needed to Account for Number, Cost, and Performance of Non-Major Programs* (GAO, 2015). EVM-Lite principles are the formalization of good management practices, not something new or a burden on a project. DOD studies have shown that EVM methods can help to resolve cost and schedule management issues that can improve program planning and execution. While Earned Value Management will not be required on Fixed Price contracts, the concepts or principles may be worth including based on the benefits of a standardized integrated Project Management tool kit. While EVM principles offer many advantages to

ACAT II and III programs, cost of implementation should always be considered. A mutual agreement on the approach should be reviewed by all stakeholders to ensure the EVM-Lite structure provides the most cost effective solution for both the contractor and the government.

VI. CONCLUSION

A. SUMMARY OF FINDINGS

The intent of this study was to research whether the use of EVM-Lite methods could provide ACAT II and III programs with the robust, cost effective, and tailorable tool kit for reporting and measuring project performance. Achieving this goal would require changes to regulations and guidance of the Department of Defense policies and training methods applicable to the use and implementation of EVM principles for ACAT II and III non-major programs. The following are the findings and recommendations for each research question:

1. What are the key issues related to data accuracy, completeness, or consistency with data received by the contractor to measure cost and schedule performance?

While the GAO research focused around the data accuracy issues reported by the non-major ACAT II and III programs, there was also an identified need for measuring project performance. To successfully address these issues the DOD would need to implement a cost and schedule measurement system, similar to EVM, for tracking project metrics. While EVM was not identified by the GAO as a proposed solution, an EVM-Lite tool that would allow flexibility in tailoring the basic concepts of cost, schedule, and performance requirements could mitigate the problem areas identified within the report. A sound EVM process would define what is being bought, how much it is going to cost, when are those costs due, what it actually costs, and how PMs can measure and quantify status if they are going to need additional time or funding. Additionally, EVM-Lite data would be provided on each contract, and this data would all be available in a centralized database to help improve data reliability, and determine how to measure cost and schedule performance (GAO, 2015).

2. **What training is necessary to address EVM gap capabilities in current training and certification programs?**

If EVM-Lite is to fulfill its role as a project management tool for ACAT II and III programs, then DOD would need to develop training sufficient to provide adequate data validations, preparing a project for an Integrated Baseline Review (IBR), and managing projects with industry standard software tools. Current EVM training must be extended to all PMs responsible for ACAT II and III programs to help strengthen their knowledge on EVM principles. Additionally, training available for contractors on implementing EVM would benefit the Government by reducing the amount of time on implementation efforts. Industry training will help to ensure the program planning efforts are using similar methods the contractor used to develop formal EVM baselines. Training will also need to be developed for analysts on the use of new IPMR spreadsheet formats, and on industry EVM Software. For example, training on how to design, implement, and operate EVM systems using these spreadsheets and software. Training must support both performing EVM on internal projects and oversight of the proper use and implementation by contractors not going through DCMA validation. EVM Analyst will be taking the place of DCMA and must ensure contractors are meeting the projects needs at the level necessary for management, while minimizing cost. Training on revised procedures and Data Item Descriptions (DIDs) that are developed for EVM-Lite will help to ensure the tasks are well understood and implemented properly.

3. **How do ACAT II and III programs apply industry ANSI/EIA-748 EVM methods and software tools to improve on measuring project performance and progress?**

The ANSI/EIA-748 Standard identifies the 32 criteria that must be implemented for a validated EVM system. Based on the intent of ANSI framework the criteria is useful for providing guidance on how to design, implement, and operate an EVM-Lite system. While each criterion in the ANSI/EIA-748 framework can be achieved in different ways, the criterion will identify what must be achieved so guidelines can be established to accomplish the program objectives. The recommendation is to apply these concepts when building an ACAT II and III EVM-Lite solution to ensure that there is disciplined control

over the project requirements. ANSI/EIA-748 compliance will still be required, but tailoring will allow much more flexibility in the implementation than currently allowed under full implementation and DCMA oversight. Tailoring should be based on well-defined requirements centered on the seven principles of ANSI/EIA-748. Software tools such as Deltek Cobra and Microsoft Project will ensure the framework provides the breakdown of the program scope into finite pieces that are assigned to resources response for control of technical, schedule and cost objectives.

4.   How PM's can get the most out of the tools and analysis techniques to build an effective EVM approach?

Finally, when considering data tools to manage an EVM-Lite approach, the Government will achieve the best results by using the same cost and schedule software tools used by its contractors. This will ensure the PMs will see the program cost and schedule baseline the same way the contractor monitors and reports the planned work. If the contractor does not have a common performance measurement tool in place then the DOD should develop Excel Spreadsheet options for the simplest, most cost effective approach. Additionally, the Government must provide instruction and support for a successful implementation approach. For larger projects, the contractor and PMs should be encouraged to look at available COTS software. Spreadsheets generally grow unwieldly on contracts over $50 million and database software is advantageous. There are a number of COTS EVM software packages available, but Deltek's Cobra and Microsoft Project EVM software is currently the most widely used by most defense contractors. If a COTS solution is not available then the simple solution is to request files specified in XML or CSV formats that can be imported into Government software tools for the analyst to oversee the contractors work. From this import file, the Government can generate the IPMR Formats 1, 2, 3, and 4, and any variations, sorts, filters, and special reports needed without contractor support. This is also the approach that OSD PARCA is currently working on. The data is submitted in a specific format and the Government will generate the necessary reports. Teaching the EV Analysts to use one tool is more effective than teaching them how to use all available EVM tools on the market. The appropriate software tool is critical for data analysis and validation requirements. While

COTS software can have large startup costs with training and implementation support the cost is minimal when compared to the benefits of measuring contract performance.

5.   Summary

EVM-Lite metrics will incorporate industries "best practices" and define performance using quantifiable metrics and will allow for actionable responses if the performance is unacceptable. When the Government does not require EVM, the larger contractors will generally use an internal EVM system to minimize their cost and schedule risk (Bembers, Knox, Jones, and Traczyk, 2017). ACAT II and III programs will need to conduct reviews with prime contractors to determine available reporting capabilities. If the contractor has an EVM system in place then the DOD should take advantage of industry's best management practices. The principles behind EVM will provide PMs with insight into early warning of cost and schedule variances so corrective action can be taken before larger variances materialize. The combination of teamwork and enlightened by an EVM-Lite implementation will help facilitate communication between all stakeholders to ensure the program successfully achieves key targets and milestones. Regardless of the reason, an EVM-Lite solution could be used to improve data quality and performance issues for ACAT II and III non-major programs that were identified in the GAO report.

B.   AREAS OF FUTURE WORK

It is recommended that the DOD develop forms and spreadsheets that can be used for small to medium ACAT II and III projects. Essentially, develop the Excel or Cobra templates that would handle the various Formats that would be expected. PMs would need a blank template, as well as a set of templates that provided a sample project for reference. A new Data Item Description (DID) with a set of instructions on filling out the forms would be necessary for building an effective EVM-Lite framework. This would be very similar (if not the same) as the instruction in the current EVM Integrated Program Management Report (IPMR) DI-MGMT-81861 DID, with adjustments where necessary. It is recommended that the DOD use the same forms to maintain standardization.

However, the EVM-Lite DID would be relaxed based on tailored methods for ACAT II and IIII programs. The Excel templates will ensure the forms are uniform with the proper formulas included.

It is also recommended that a new simplified EVM-Lite guide provide written direction on how to implement the approach to ensure that the precepts of EVM are maintained, while relaxing the areas that drive up cost and complexity. This would primarily be in the areas of the WBS, the depth of WBS, the amount of LOE and scheduling required, and conducing an IBR. There would need to be specific guidance, rather than direction.

Research could also be done on additional training necessary to support the new EVM-Lite approach. This may be a significant effort depending on the available training resources within DOD. If and when an EVM-Lite framework were to be implemented on DOD work, then the training would be more extensive. That is when the EVM Analysts would have to learn how to design, setup, operate, and validate an EVM cost and scheduling system (in Excel or Cobra). This requires an all-encompassing training compared to what DAU currently provides for the DOD.

Finally, further research may be done on DOD programs that initiated an EVM-Lite approach on non-major ACAT II and III programs. The research would demonstrate whether a tailored EVM approach provided PMs with a reliable cost, schedule, and performance toolkit to help build an effective project management solution.

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